THE MATHEMATICS TEACHER

EDITED BY
W. H. METZLER

ASSOCIATED WITH

EUGENE R. SMITH HARRY D. GAYLORD
GEO. GAILEY CHAMBERS WILLIAM E. BRECKENRIDGE

VOLUME X DECEMBER, 1917 NUMBER 2

EDITORIAL.

In this time of national stress the government has a right to expect the highest degree of co-operation from educators and educational institutions. In the attempt to secure this co-operation, the Department of the Interior has announced the issue, through the Bureau of Education, of "Lessons in Community and National Life."

These lessons are being issued monthly, from October to May, in grades suited to pupils of different ages. One series is for the fourth, fifth, and sixth grades, the second goes through the first year of high school, and the third is adapted to the upper three years.

The courses correlate well with English, geography, history, civics, and current topics, so they can be used to advantage in the time devoted to these subjects, even if they are not given a time of their own.

The Bureau of Education is also sending out Home Economics letters of the greatest value to the home and the school.

We urge all of our readers to use their influence toward a wide use of this material in the schools.

THE TEACHING OF MATHEMATICS IN THE JUNIOR HIGH SCHOOL.*

(A Discussion of the Rochester Plan.)

By William Betz.

Synopsis.

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Introduction.

Any consideration of so extensive a topic presupposes a clear statement of the method by which one expects to disentangle the maze of interacting factors which seem to underlie the situation to be discussed. Undoubtedly there are several ways of approaching the question that is before us. The controlling idea in the mind of the writer, however, was the necessity of putting

* This paper is intended as a summary of several preliminary reports presented at meetings of the Rochester Section and at the Trenton meeting of the Association, April 28, 1917. It is based on a report submitted to the school authorities of Rochester. For the sake of brevity the discussion emphasizes only the academic course. A differentiated curriculum in mathematics is in operation for pupils in the commercial course and in the industrial and household arts courses.

into bold relief, if possible, those elements which above all others are significant in the evolution of a satisfactory mathematical curriculum.

In former years investigations of this type were conducted almost entirely from a pedagogic standpoint. If schoolroom results were poor, it was customary to attack the teacher, or the textbook, or—more rarely—the examination. The curriculum was stoically accepted as something essentially unalterable. Pupils were treated to a fixed menu of courses, of topics and methods, until their increasing mortality called imperatively for remedial measures. Very gradually it has dawned upon educational authority that democratic education, especially in our big American cities, presents such a multiplicity of embarrassing aspects that an offhand, machine-made solution, of which we are usually so fond, is entirely out of the question. Only genuine, careful experimentation can be of avail. It is a pleasure to note that Rochester has officially taken this sane attitude. After two years of experience in the new junior high school the attempt is to be made to offer a first tentative summary of experiences and results, and thus to obtain, if possible, a revised and improved program for the next forward movement.

As has been suggested, the question of mathematics in the junior high school is by no means exclusively a pedagogic one. Innumerable factors over which the teacher has no control, factors which are essentially administrative or social, often outweigh in importance all other considerations. Hence the report which is to follow will have to give due attention to at least three phases of the problem.

1. The Pedagogic Elements of the Question.

1. *Aim.*—It is doubtful whether any other educational item has received more careful attention in the last fifteen years than the teaching of mathematics. In 1912 the United States Bureau of Education published a special bulletin containing a bibliography of 1,849 titles, all pertaining to books, memoirs, and pamphlets

* The Washington Junior High School opened its doors in September, 1915.

written since 1900, either here or abroad, on the teaching of mathematics. An international commission was created to unify and standardize the mathematical teaching of all the civilized countries. As a result, scores of valuable treatises and reports have come to us. Surely, a subject of such vitality, at once the oldest, the most progressive, and the most far-reaching, of all the sciences, deserves serious consideration, on purely a priori grounds, in the curriculum of any school.

Nevertheless, mathematics cannot be said to be an extremely popular subject. This is due to several reasons: (1) rigorous thinking, at best, is not a pleasant task to most people; (2) the results of mathematics are of a cumulative character, *i. e.*, the subject must be studied in a strictly progressive order, and therefore losses due to absence or neglect often cause failure; (3) the teaching of the subject has failed to emphasize the inexhaustible range of mathematical applications, but has given almost exclusive attention to theory; (4) the brief period of time allowed for teaching the subject has made it impossible to cover more than the fundamentals, and even these in a very perfunctory way, thus giving a wholly distorted and inadequate conception of the purpose and scope of mathematics.

Hence the anomaly has arisen, under the influence of a socialized pedagogy calling for immediate educational returns, that mathematics, the oldest and most indispensable of all sciences, has been driven into a defensive position. The mother of all sciences is requested to *justify* her appearance in the class room. Why ask every boy and girl to give "so much valuable time" to this terrible, uninteresting, dry-as-dust array of symbols and formulas? The mathematical apologist, therefore, has before himself the inviting task of explaining "what there is in mathematics that the working man needs and what of this science the woman requires in directing the education of her children and in managing her home; how mathematics trains the mind and how its poetry affects human life; what potency the subject has in the uplift of the soul of you and of me; how it has linked itself with all humanity in all times; and how we should go about to make all this real in our everyday teaching."

Fortunately, able pens have taken up this defense. An increasing volume of literature is becoming available to all who

take an interest in this problem. Even the layman will derive both benefit and pleasure by reading such excellent summaries as those of Professor C. J. Keyser,* of Columbia University, and of Professor D. E. Smith,† of Teachers College. He will find that to well-informed persons this agitation against mathematics is amusing, because it is not only useless, but also without point. He will find, moreover, that honest critics distinguish sharply between mathematics as a science and the pedagogy of the subject. It is granted without a moment of hesitation that much, very much, remains to be done to make mathematical teaching what it may and should be. There is ample evidence, nevertheless, that the criticisms constantly directed against the teaching of mathematics may with equal justice be brought against any other school subject. Does history function, or literature, or music, or penmanship, or biology? If not, why teach them? The absurdity of such a position forces a candid investigator to confess that our educational shortcomings are not necessarily inherent in the subject-matter taught, but rather in the whole intricate educational problem of the twentieth century.

It cannot be denied, however, that the insistent attacks on mathematics during recent years have had the extremely valuable effect of focusing attention on the aim of all mathematical instruction. For if no satisfactory reason can be given for including this subject in the curriculum of a junior high school, it should certainly be dropped.

Briefly stated, there are three main reasons for asking boys and girls to pursue at least an elementary course in mathematics.

First, mathematics is the basis of practically our entire material civilization. Without it we should return to primitive conditions. To an extent which it is almost impossible to exaggerate, our entire business life, including manufacturing and transportation, our engineering enterprises, architecture, sciences such as physics, chemistry, economics, astronomy, statistics, and

* C. J. Keyser, "The Human Worth of Rigorous Thinking," Columbia University Press, 1916.

† D. E. Smith, "Mathematics in the Training for Citizenship," *Teachers College Record*, May, 1917.

even psychology, are absolutely dependent on the ideas and processes of mathematics.

The marvelous shorthand of algebra, which "says more in fewer words than any other language," and the mensurational power of geometry, enter in so many ways into the world's ordinary affairs that a boy or girl ignorant of the first principles of mathematics would be handicapped both from a standpoint of general culture and of life preparation. Hence it is undeniable that on the basis of practical utility alone the teaching of mathematics can be fully justified.

A more difficult task is encountered if, secondly, we attempt to explain the usual mathematical curriculum by means of the customary argument that it offers an unparalleled opportunity for mental training. No other contention has been debated more fervently during recent years. It seems that the whole matter is largely a matter of phraseology. As the smoke of battle is lifting, it is becoming clearer and clearer that the famous doctrine of mental discipline has not been disproved and never will be disproved, and that both its extreme advocates and its extreme opponents are wrong. Whether one prefers Thorndike's* conception of "identical elements," or Judd's convincing theory of generalized experience, the truth is that "no one denies the fact of transfer of training." The following quotations from Judd† have a particular bearing on our subject:

"The real questions at issue are what is the degree of transfer and what is its method" (p. 405).

"The negative evidence offered by the critics of formal discipline thus turns out to be of the thinnest possible type. They have not only not proved a negative; they have presented a series of facts which calls loudly for affirmative discussion" (p. 412). "Formalism and lack of transfer turn out to be not characteristics of subjects of instruction, but rather products of the mode of instruction in these subjects" (p. 413). "The

* Thorndike, E. L., "Educational Psychology," 1913, Vol. II., Chap. XII., especially pp. 430 and 431.

See also Ruediger, W. C., "The Principles of Education," Houghton Mifflin Co., 1910, Chap. VI.

† Judd, Ch. H., "Psychology of High School Subjects," Ginn & Co., 1915, pp. 392–435.

problem of education thus turns out to be the problem of generalizing experience" (p. 419). "The generalizing of experience is a qualitatively new fact wherever it appears" (p. 420). "A subject which gets itself so organized that it rotates around its own center immediately becomes formal. . . . The opposite of formalism is not emphasis on content, but emphasis on application. Any content may become formal. Any mode of procedure may become formal. Opposed to 'formal' is such a word as 'vital.' That is not formal which moves forward to new applications. Generalized knowledge is not formal. Knowledge which is being used in applications, either in the evolution of higher thought-processes or in the solution of practical problems, is not formal" (p. 421). "Application is, however, a most difficult mental process, and needs to be learned just as the original principle itself has to be learned. . . . Successive examples, therefore, should be treated as the opportunity on the part of the teacher to cultivate the attitude of application" (p. 422). "The teacher ought to recognize in all of these cases that the mere solution of the problem is of slight importance if the student does not acquire that higher power of discovering the mode of procedure which is appropriate in each case" (p. 423). "Those who have opposed the doctrine of formal discipline by saying that the school subjects at the present time do not give a generalized training are undoubtedly criticizing not the human mind, but our methods of instruction" (p. 424). "There is no adequate justification for the loud contention of the newer subjects that the older subjects of the curriculum are inherently formal and of necessity narrow in the effects which they produce on students' minds" (p. 425). "The mastery of the general principle is therefore a new type of mental achievement. . . . The discovery of this general principle or rule is a new performance; it is an expression of the power of generalization. The cultivation of this power of generalization is the most important achievement in the student's education. It will not come without special endeavor on the part of the student and on the part of the teacher" (p. 432).

Let any one attempt to find a subject in the whole curriculum to which Judd's ideas of generalized training could be more easily applied than in the field of mathematics. Since in our

everyday experiences we are constantly encountering quantitative relations and problems, and since our thinking is very largely deductive, it is evident that training in mathematics, if it is properly conducted, *must* carry over into the affairs of life. Surely no other subject in the curriculum offers more points of contact between theory and practice than does mathematics. It is no accident that for four thousand years this subject has demanded attention with increasing persistence. We may no longer be able to cultivate in the minds of boys and girls that sheer enthusiasm for geometry, rhetoric, music and the other fine arts, which characterized the education of Greece during the period of her greatest splendor. We may never again desire, like Pythagoras and Plato of old, to refuse admission to the gates of the educational palace to any one unacquainted with mathematical learning. It is, however, the combined testimony of innumerable witnesses that the study of mathematics, under adequate guidance, will and does leave upon the mind an indelible impress of permanent value, a testimony which is not shattered by the recent literature of mental discipline.*

From a utilitarian standpoint, therefore, mathematics ranks in importance with reading and writing, while its "disciplinary value" is not exceeded by that of any other subject. Perhaps it is unfortunate that this should be so. For this very fact has served to overshadow completely the third aim of mathematical studies, undoubtedly the most fundamental of all. Neither practical considerations nor formal discipline alone have caused the gigantic development of mathematics, either past or present. Behind it all was a far deeper impulse. Is it chance that the list of the world's noted mathematical thinkers includes the greatest philosophical geniuses of all time, men like Pythagoras, Plato, Descartes, Leibnitz? Or is it accident that the *mathematical* university of Cambridge, England, trained many of England's greatest poets, and not *literary* Oxford? It was

* Teachers of mathematics are greatly indebted to Dr. H. O. Rugg for his careful study, from a mathematical standpoint, of this vexing problem. It is a pleasure to refer to his recent monograph: "Experimental Determination of Mental Discipline in School Studies," Warwick and York, 1916. His conclusions are distinctly affirmative (see pp. 114–116). The book also contains a valuable chronological bibliography.

a poet who asserted that "the life of the gods is mathematics." Said Plato, "God always geometrizes;" and Gauss, that prince of modern mathematicians, exclaimed: "God always arithmetizes."

What is mathematics? It is difficult, if not impossible, to give a brief and concise definition of this many-sided branch of learning. The mathematical sciences have ever maintained a close relation to philosophy. They have assisted in the continual endeavor to explain this world of a myriad ideas and of countless bewildering phenomena as a unified system controlled by law. The mathematician really tries to reduce all thinking to its ultimate bases and to comprehend the physical universe by means of a few fundamental concepts such as mass, energy, space and time. In short, it is the passion for infinite harmony in a world of apparent chaos that has caused the mathematician to go on and on in relentless endeavor. The infinitely small and the infinitely large have together engaged his unremitting attention through the ages. Behind all this effort, as Professor Keyser says so beautifully, there is the truly religious conviction that "transcending the flux of the sensuous universe, there exists a stable world of pure thought, a divinely ordered world of ideas, accessible to man, free from the mad dance of time, infinite and eternal. Mathematics is, in many ways, the most precious response that the human spirit has made to the call of the infinite and the eternal. It is man's best revelation of the 'Deep Base of the World.'"

Every mathematical formula represents a storehouse of information, erected by ceaseless toil. Arithmetic, geometry, and algebra have made possible this storehouse; they furnish the key that unlocks its doors and releases the treasures of the past. To comprehend, even in a rudimentary way, that this universe is a world of law; to experience the economy and joy of ordered thinking; to sense, however slightly, the eternal symmetry implanted in the geometry of form; to see how a systematic body of universal principles is discovered and demonstrated—surely this is an ethical equipment, and a training in appreciation, of incalculable importance and beauty.

Needless to say, this trilogy of aims is realized only very imperfectly in the ordinary class room. In the standard four-year

curriculum, with its one year of algebra and one year of geometry, almost exclusive attention is given to formal technique. Rarely, if ever, does the pupil suspect the existence of a rich body of applications, not to mention the higher considerations referred to above. Lack of time is the invariable excuse given for this usual poverty of content. Hence, if the junior high school is to justify itself in the eyes of the scholar and of the general public, along mathematical lines, it must so administer its subject-matter and its methods, and must make such a time allowance, that the higher mathematical aims will also have a chance to come to light.

2. *Subject-Matter.*—Mathematics originated through counting and measuring. Hence, arithmetic and geometry have become the foundations of mathematics. Both sciences have a history of thousands of years. The third branch of elementary mathematics, algebra, developed much more slowly. Its present form came into existence during the past four centuries. Yet its vast importance is inversely proportional to its youth.

The mathematics of the junior high school must, therefore, comprise the rudiments of arithmetic, geometry and algebra. These subjects must be so distributed and adjusted that the major aims of mathematical instruction are constantly kept in mind. Experience shows that the following minimum program in an academic course is feasible:

Arithmetic.—During the seventh year the work includes thorough reviews and drills in the fundamental processes, the three "cases" in percentage, with applications (profit and loss, commission, simple discount, trade discount, insurance, simple interest, bank discount) and suitable problems suggested by these topics. All this material, as outlined in the official suggestions of Director Charles E. Finch, is kept under review and is gradually extended during the eighth year. In the ninth year the effort is made to correlate arithmetic and algebra at every point, both in theory and practice.

Geometry.—The work at present comprises these topics: historical introduction, classification of forms, preliminary designs, followed by a systematic study of lines, circles, angles, triangles, polygons, parallels, symmetry, congruence, surveying, and the areas of geometric figures, both simple and composite. A spiral

arrangement of topics has been devised which secures a maximum of review and application.

The use of geometric instruments is emphasized through numerous constructions and designs, and great attention is given to clearness of perception and expression. The work at first is entirely observational and intuitive, but by slow degrees rational processes are introduced. A more ambitious program, including a study of volumes and of similarity, was outlined originally. This may still become a reality, as soon as more time is provided. It was thought wiser not to sacrifice thoroughness to breadth.

Algebra.—A brief historical introduction is followed by simple concrete exercises involving the first fundamental principles of the science. This preliminary work is to a large extent given in geometric form. It gives due attention to simple formulas and graphic methods. The subsequent study of very simple equations is conducted in a thoroughly objective way. A set of carefully graded number problems serves to connect algebra with arithmetic and geometry. Algebraic multiplication is based on a discussion of areas and volumes. The use of short processes is emphasized throughout the course. Methods of checking are taught with great care. The work of the eighth year also includes a study of square root and of the Pythagorean Theorem with suitable applications. During the ninth year the topics prescribed by the State Syllabus are completed. As far as the limited time allotment permits, the correlated type of mathematics begun during the eighth year is continued. At the end of the ninth year, therefore, the pupil is ready to begin a study of demonstrative geometry with a far more adequate preparation than can be given in the usual high-school curriculum.

Method.—If any subject depends for its vitality and the richness of its appeal on the method chosen, it is mathematics. In general, three methods may be employed in the school room. The first may be characterized as the *systematic* or *logical* method. It is comparable to the old grammatical method of studying languages. It begins with definitions and rules whose purpose is revealed to the learner only as the work progresses. Such a logical plan may be attractive to the adult mind; to the young learner it is repulsive and uninteresting because it leads him through the subject blindfolded and without a comprehen-

sion of the underlying scheme. The second method may be called the *problem* method. Its purpose is to develop the subject in connection with a carefully chosen series of progressive problems. Admirable though this procedure is, experience shows that it is too slow and rarely furnishes a sufficient basis for drill and technique. Hence a third procedure, a compromise between the first two methods, is more desirable. Its aim must be to preserve as far as possible the solid technique of the old dogmatic method, while at the same time it infuses into the subject the interest and direct motive of the problem method. In the junior high school this attempt has been made in the following manner: Each individual pupil has a notebook and the work is developed strictly on a laboratory basis. Each new principle is introduced by means of simple concrete exercises. The underlying inquiry always is, "what do *you* see?" or "what do *you* think?" In other words, the first purpose of every lesson is to secure insight and motive. When this result has been reached, the pupils enter in their notebooks a summary of the discussion, under the direction of the teacher. Then follows a series of drill exercises, continued, if necessary, on successive days until a satisfactory degree of speed has been attained. These drill exercises are either given by dictation, or are written on the blackboard by the teacher, or are contained on mimeographed sheets. At the same time every effort is made to find for each principle a suitable set of applications. Thus it is seen that the method of instruction is dominated by the three ideas of insight, skill, and appreciation.

In the junior high school supervised study has also been in operation since the opening of the school. It is too early to speak in any final way about its merits and defects. Its undoubted advantage is that it tends to develop the entire class as a unit, while at the same time it points out sharply individual differences in the rate of advance. The teacher usually knows rather definitely to what extent a lesson has been assimilated by the class. The defect of supervised study when combined with the laboratory method is the unintentional retardation of the brilliant pupil, who must wait until his slower companions "arrive," and the hopeless condition of those who are frequently absent. Both of these defects, however, are now

being remedied to a certain extent by the study coach system and by differentiated assignments.*

One other point should be noted under the heading of method. In the upper high school the various branches of mathematics are usually taught by themselves, in water-tight compartments. In the junior high school it has become possible to do far more correlating of the right kind. The early introduction of geometry especially has been a great aid in making clear algebraic principles and processes which otherwise would remain hazy. As far as possible all the important principles of mathematics are kept under review, thus insuring a greater skill in the use of all of them and an increased probability of their permanent retention. Our experience does not favor the various fusion plans which have been advocated in several parts of the country. We are still to be convinced by practical demonstration that such fusion does not ultimately lead to confusion. At any rate, a satisfactory program along the lines of the fusionists, one that will stand the test of the ordinary class-room, is still to be announced.

It is undeniable that the old high-school curriculum failed signally in not creating insight or motive, in not securing a permanent grasp of principles, methods and processes, and in ignoring—through lack of time—even the most obvious applications. All these neglected features must be cultivated by the junior high school. A beginning has been made in each of these directions. Above all, from the outset each important principle is consciously developed and all processes are treated rationally. Thus, in algebra the fundamental rules of order, grouping, and distribution are made explicit again and again. In other words, the merely mechanical juggling of symbols and figures is discouraged. By this policy we may hope to overcome that unfortunate conception of mathematics which is so ably satirized by Oliver Wendell Holmes in this biting com-

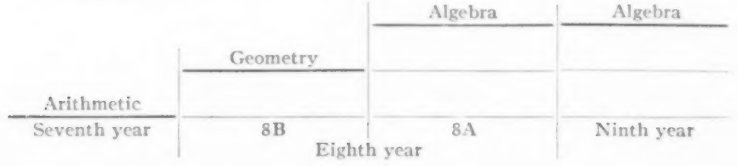
* This phase of supervised study is discussed very ably by Mr. I. M. Allen, in "Experiments in Supervised Study," *School Review*, June, 1917, pp. 398–411, although one feels strongly inclined against "auto-assignment of lessons." A good summary of the whole question of supervised study is contained in a recent article by Mr. H. C. Hines, of Iowa State University. (See "School and Society," Nov. 3, 1917, pp. 518–522).

ment: "I have an immense respect for a man of talents *plus* 'the mathematics.' But the calculating power alone should seem to be the least human of qualities, and to have the smallest amount of reason in it; since a machine can be made to do the work of three or four calculators, and better than any one of them. Sometimes I have been troubled that I have not a deeper intuitive apprehension of the relations of numbers. But the triumph of the ciphering hand-organ has consoled me. I always fancy I can hear the wheels clicking in a calculator's brain. The power of dealing with numbers is a kind of 'detached lever' arrangement, which may be put into a mighty poor watch. I suppose it is about as common as the power of moving the ears voluntarily, which is a moderately rare endowment."

Now all these details of subject-matter and method require for their fullest development a curriculum which makes adequate provision for both the proper sequence of the various mathematical topics and for the period of time which experience has shown to be necessary for their proper assimilation. This brings us to the second main aspect of our question.

II. Administrative Elements of the Question.

1. *The Curriculum.*—The way in which arithmetic, geometry, and algebra are at present distributed over the three-year period of the junior high school may be explained by the annexed diagram.*



The heavy lines indicate at what time an intensive study of each subject is begun and how long it is continued. The light lines show how long each subject is dormant or is correlated with other subjects.

*The school year is divided into two semesters. The first semester is indicated by the letter B, and the second semester by A.

In other words, geometry is now begun in the eighth year and is continued for one semester. Algebra is assigned to the second half of the eighth year and is continued for one and one half years. Historically, this sequence is the only correct one. Geometry must come before algebra. It would be a pleasure, if space permitted, to quote at length from the reports of mathematical societies and of prominent educators concerning this point. Also, it would be extremely valuable to conduct a symposium regarding the best time of introducing each subject.* Much light has been thrown on this problem by the work of the International Commission on the Teaching of Mathematics. It may be helpful to append here a few data, in tabular form, based on J. C. Brown's summary of the world's curricula in mathematics. From his study of foreign curricula, as outlined in reports of the International Commission, Mr. Brown draws comparative conclusions which it would be unfortunate to overlook at this point. He says, in part: "The European schools are doing certain kinds of work that we are not doing, some that we can not hope to do under present conditions, and some that we might not care to do if we could. They are also doing some work that we wish we could do, and some that we shall probably do before many years have elapsed.

"In every country of Europe the secondary-school period extends over at least six years. In most of the countries the majority of the teachers above the primary school have had the advantage of college or university training. The teachers have a margin of scholarship that is not common among teachers in the United States.

"Abundant provision is made for daily drill in mathematics.

* Teachers who are interested in the proper sequence of mathematical subjects should not fail to read "A Study of Mathematical Education," by the distinguished English educator Benchara Branford, published by the Clarendon Press. Dr. T. Percy Nunn, of London, whose books should be in every mathematical library, says of Branford's book that it is "the most important and original of recent English contributions to the pedagogy of mathematics." The question of the earlier introduction of geometry is discussed in Judd's "Psychology of High School Subjects," pp. 20–22, and in Superintendent Morrison's monograph on "Reconstructed Mathematics," p. 26 (see reference at end of this paper).

The educator of Europe realizes that this daily drill is absolutely necessary in order to give the pupil a real mastery of number facts and relations. A little smattering of the subject will not suffice. The pupil is expected to know thoroughly certain facts and principles, and to this end daily drill is provided. No small part of the thoroughness in detail, which is so characteristic of most of the schools of Europe, may be traced to this drill. The American pupil has some information on a great variety of topics, but much of his knowledge is vague and indefinite, rather than clear-cut notions about definite things.

"Everywhere algebra is introduced earlier than in the United States. In certain of the German schools some work in algebra is introduced during the sixth year, and in no country, except the United States, is this introductory work postponed later than the seventh school year.

"Some instruction in constructional, observational, or intuitive geometry is always offered during the sixth, seventh and eighth school years. This instruction is always of a propædeutic nature. Much emphasis is placed upon estimates and constructions.

"In all of the schools of Europe algebra and geometry are studied simultaneously during a considerable number of years. The various mathematical subjects are more closely correlated than in this country. A pupil who is studying geometry can use his arithmetic and his algebra more readily than is the case with the average American boy. The introduction of the trigonometric functions while the pupil is studying similar figures in geometry has the sanction of most of the best teachers abroad. The distinction between plane and solid geometry is much less marked than in this country. This is due, in part at least, to the fact that models are very extensively used in the study of geometry.

"Everywhere the attempt is being made to find genuine applications of mathematics that are really within the experience of the pupil and to link the subject of mathematics as closely as possible with the activities of real life. Drawing and physics are frequently taught by the same teacher, and the correlation between these subjects is found to be to the advantage of each.

"European school men believe that a course in mathematics should be planned by those who know some mathematics rather

than by educators who are practically ignorant of the subject. The reports do not indicate that the schools of Europe are hear-

TABLE I.

YEARS OF STUDY OF ARITHMETIC.

School Year.	1.	2.	3.	4.	5.	6	7.	8.	9.	10.	11.	12.	13.
Austria													
Volksschule	—	—	—	—	—								
Bürgerschule						—	—	—					
Gymnasium					—	—	—	—	—				
Realschule					—	—	—	—	—				
Realgymnasium					—	—	—	—					
England													
Elementary	—	—	—	—	—	—	—	—					
Secondary										—			
France													
Primary	—	—	—	—									
Higher primary					—	—	—				—		
Lycée					—	—	—	—					
Germany													
Volksschule	—	—	—	—	—	—	—	—					
Bürgerschule				—	—	—	—	—	—				
Gymnasium				—	—	—	—	—	—				
Realgymnasium				—	—	—	—	—					
Oberrealschule				—	—	—	—	—					

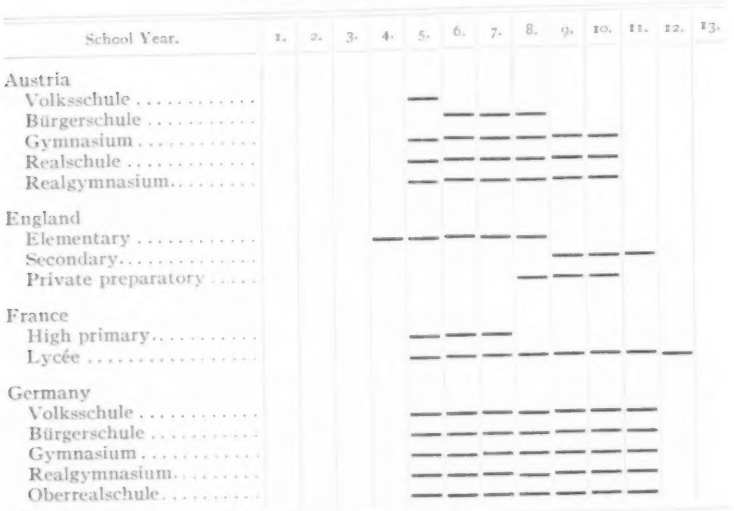
TABLE II.

YEARS OF STUDY OF ALGEBRA.

School Year.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
Austria													
Bürgerschule							—	—					
Gymnasium							—	—	—	—	—		
Realschule							—	—	—	—	—		
Realgymnasium							—	—	—	—	—		
England													
Elementary							—	—					
Secondary									—	—	—		
Private preparatory								—	—	—	—	—	
France													
Higher primary						—	—						
Lycée						—	—	—	—	—	—		
Germany													
Bürgerschule							—	—	—	—	—		
Gymnasium							—	—	—	—	—		
Realgymnasium							—	—	—	—	—		
Oberrealschule							—	—	—	—	—		

TABLE III.

YEARS OF STUDY OF GEOMETRY.



ing a demand for weak algebra and anemic geometry, or even for no work in these subjects. If any pressure of this sort exists, it has hitherto produced no modification of the course of study."

2. *The Time Element.*—Compared with the above tables, our present arrangement is not ideal. Its disadvantage is that geometry is not begun early enough, that a relatively excessive amount of time is given to arithmetic, and that too little time remains for algebra. This will become clearer from a consideration of the tentative time schedule of the last two years:

Arithmetic: Seventh year : 390 minutes per week, no home lesson.
Arithmetic: Eighth year : 135 minutes per week, no home lesson.
Geometry: Eighth year (B) : 225 minutes per week, no home lesson.
Algebra: Eighth year (A) : 225 minutes per week, no home lesson.
Algebra: Ninth year (B) : 435 minutes per week, including one home lesson.
Algebra: Ninth year (A) : 480 minutes per week, including two home lessons.

* In the 9B class, one home assignment a week was allowed, and in the 9A class two home assignments were given, each estimated at 45 minutes.

A further investigation of the time allotment reveals the fact that the junior high school, under this organization, is giving hardly as much time to algebra as the upper high school in its ninth year. The following computation verifies this statement: In the upper high school (*e. g.*, East High School of this city) the available time allotment for algebra, making allowance for home study and regular interruptions, is 480 minutes per week; or, for a period of 38 weeks, a nominal allowance of *18,240* minutes. The junior high school schedule in algebra, during the past two years, is illustrated by the annexed table:

Eighth year A:	225 minutes per week.	
	19 weeks.	
	2,025 minutes.	
Ninth year B:	435 (390 + 45) minutes per week.	
	19 weeks.	
	8,265 minutes.	
Ninth year A:	480 (390 + 90) minutes per week.	
	19 weeks.	
	9,120 minutes.	
Total nominal time, not counting interruptions		21,660 minutes.
Regular interruptions (estimated)		3,960 minutes.
Actual total		17,700 minutes.

We have, then, a time schedule of 18,240 minutes in the upper high school, compared with 17,700 minutes in the junior high school.

This discrepancy is not large in itself, but it becomes serious when it is recalled that the upper high school has been entirely unable to do satisfactory work, largely because of its time element. How can the junior high school expect to do better by taking even *less* time?

It is true that supervised study combined with the study coach system is proving a help in many cases. On the other hand, the *absence* of home study in the eighth grade, with only 45 minutes a day available for preparation, presentation, and drill, is an element of retardation, since it takes slow pupils so much longer to find their way back to the territory covered during the previous lesson. Now, unless the junior high school is to cause the same mortality which is customary in the upper high school, it must gauge its progress by the attainments of the "average" pupil. Experience shows that under our present organization, *i. e.*, with supervised study, no home study, and

only 45 minutes a day in the eighth grade, the initial rate in geometry and algebra is found to be much slower than in the upper high school. Hence the apparent time budget of 17,700 minutes for algebra is actually much below the desirable minimum.

This brings up the question of remedial measures. Only two things can be done. Either geometry must be put into the seventh grade, or more time must be allowed for algebra in the ninth year. Perhaps a combination of both plans would be even better.

The consensus of mathematical educators is that geometry should be begun as early as possible, and certainly before algebra. It cannot be denied that a very heavy allowance is made for arithmetic in the seventh grade. Jessup found ("Elementary School Teacher," 1914, 461–476) that the median time spent upon arithmetic in the seventh grade of American public schools is 150 minutes; in the eighth grade, 165 minutes per week. Our own figures were stated above. Hence it should be possible, in the course of time, to provide for some geometric instruction in the seventh grade, where it belongs. The average time allotted to arithmetic in fifty representative cities is 140 hours in the seventh grade, and 142 hours in the eighth grade, or a total of 282 hours in both grades. Our total is 332 hours in the same grades of the junior high school. If this excess of 50 hours were devoted to geometry in the seventh grade, it would mean 30 minutes a day for one entire semester. Certainly this fact deserves serious attention.*

3. *Equipment.*—The junior high school cannot do its best work without a satisfactory material equipment for mathematical instruction. This includes books, models, illustrative charts, pictures, diagrams, graphs, laboratory devices and instruments,

* A new time schedule was adopted in September, 1917. Under the new plan 90 minutes a day are given to mathematics throughout the ninth year. This means the "divided period" plan. Home study is eliminated entirely. Even this new algebra schedule exceeds that of the upper high school by only two weeks; a very narrow margin, if we recall the slower initial approach and the possibility of interruptions. Hence the time element continues to be a very weighty question. In fact, the success of the junior high school is thus made to depend primarily on expert teaching and on supervised study.

a permanent display of representative notebooks and papers written by pupils, a surveying outfit, industrial and commercial products of mathematical importance, and—if possible—a projection apparatus. Much of this material is being collected now. Two interesting exhibits have occurred so far. The shops of the school furnished admirable models of transits. Many devices were improvised and each teacher is helping to contribute to the mathematical resources of the school. The time will come when all this material will have to be placed in a central distributing room, so that it can be made available to all classes. At present our greatest need is the building up of a professional library for teachers.

No regular textbook has as yet been adopted. In the eighth year no text whatever is being used by the pupils in either geometry or algebra. In the ninth year we use two supplementary texts for drill purposes and assign home lessons from the adopted high-school text. This plan is succeeding very well.

III. Social Elements of the Question.

No discussion of any feature of our work would be complete without a brief reference, at least, to the social organization of the school. Each home room has its group of officers. These officers, each group under its faculty adviser, constitute an executive body of considerable size. In this way many civic activities can be closely imitated. For one thing, a species of self-government is made possible, which is rendering the discipline of the school remarkably easy and perfect. Besides, the experiments conducted so far along the line of socialized recitations have had a quickening influence even on the stately subject of mathematics. A sincere tribute is due to the management of the school which has given unremitting attention to the details of its civic development.

1. *The Teacher.*—Next in importance to a satisfactory school organization comes, of course, the teacher. Given a good teacher, many difficulties will vanish. With a poor teacher even the best system is useless. It is a source of great gratitude that the Washington Junior High School has been blessed with a conscientious, efficient, and enthusiastic body of teachers. There has been no friction or unpleasantness of any kind. The way in

which these teachers, practically all of them from the grammar grades, prepared themselves, by means of twenty Saturday institutes, for their first pedagogic efforts in secondary mathematics, has been described officially in several reports.* Of course, all the teachers feel the urgent need of further growth in scholarship. A number of them have taken steps to supply this want privately at their own expense. It would seem that the city, in collaboration with the higher institutions of learning in our community, should offer a further training course for its teachers, at a very nominal cost. Nothing would add more to the efficiency of the schools.

The mathematical experiments of the junior high school were carried on in the following manner. The writer usually taught two classes a day, not counting days of testing and written reviews. The regularly designated class teacher, who was always present, furnished a detailed written report on each lesson taught, containing practically every question and answer, every exercise, a statement of the time occupied and of the response and attitude of the class. These reports were duplicated and distributed among the teachers. We have now complete lesson outlines of every phase of the work. They represent an invaluable set of documents, made possible by the careful, painstaking effort of the teachers.

After the first experiments had been completed, the teachers reported their own independent results in a more condensed, weekly summary. This included an estimate of the time given to the various parts of each lesson, such as review, advance, drill. Hence we have a second important set of data for further adjustments. In view of the vexing time problem referred to above these weekly abstracts were found indispensable.

A further item of general interest is the careful study that has been given to the individual response of the pupils in each of the reviews and tests. The teachers usually computed the median grade and furnished the frequency table of the class. In this way a valuable check was obtained on the difficulty of each topic and on the average deviation of each group of pupils. This made possible the application of remedial measures. Thus,

* Superintendent H. S. Weet's reports were published in *School Review*, 1916, pp. 142–151, and in *Educ. Ad. and Super.*, 1916, pp. 433–447.

two classes which were found to be distinctly bi-modal were reorganized during the past term into two more homogeneous groups, and the slower group received additional attention. Also, topics which were found too hard were given a more adequate treatment or were transferred to a later period in the course.

In short, the teachers are leaving nothing undone that is likely to make the mathematical work of the school a source of maximum benefit and interest.

2. *The Pupil.*—The Washington junior high school has a thoroughly democratic body of pupils. The foreign element predominates, the majority of the children being of Hebrew, Polish, or Italian parentage. In such a school problems of individual differences and of vocational guidance are of paramount importance. Every effort is being made to diagnose each individual case as fast as the data become available. Experience shows that the children are of average mental ability. As a rule it is not difficult to arouse their interest, but *much* harder to secure permanent retention of facts, principles, and processes. A certain dullness or mental sluggishness, noticeable in a number of the pupils, may be due to economic factors or other unfortunate home conditions. In the opinion of the writer, few things are more essential than a differentiation of pupils according to ability. Nothing whatever is gained in mathematics by hurrying over material that is not comprehended. The slow pupil often needs three and four times as much time as the brilliant one. It seems unfair to both to harness them in the same team. Careful investigations show that in the high schools of the state and of the country about 5 per cent. of the pupils may be called *excellent* (rating 90–100 per cent.), about 25 per cent. are satisfactory (rating 75 per cent.–89 per cent.), while 70 per cent. are *slow*. If the 30 per cent. whose record is good could be put into separate classes, they would do twice as much work, and the slow children, by advancing more cautiously, would get much more out of their course, too.

Fortunately, comparative statistics on the merits of differentiation are at hand. In Europe, for example, the secondary and certain elementary schools automatically exclude the children of the masses by a small tuition fee. This tends to place

a select group of pupils into the "pay schools." Without desiring to imitate that kind of differentiation, we may still be interested in the effect. The city of Breslau, Germany, recently found that the children of the Vorschulen (*i. e.*, primary schools preparing directly for the high schools) are an entire year ahead of the children in the free Volksschulen as early as the third grade. Still more startling are the figures published by the authorities of Bremen, Germany.

In the United States the most noteworthy recent experiment in differentiation along more democratic lines, and under test conditions, is that of the Speyer School, New York City. The avowed purpose of the experiment was to secure a group of promising seventh grade boys from the neighboring grammar schools of the city, who intended to elect a classical high-school course, and to enable them to complete the work of grades 7, 8 and 9 in two years. Under the auspices of Teachers College about 200 boys were thus chosen, in January, 1916. On the basis of a series of careful, preliminary tests, both psychological and educational, the boys were graded according to ability into eight groups, homogeneous as to ability. Each group was given the same work, but was encouraged to progress at its optimum pace. A visit to the institution readily impressed the writer with the scientific accuracy of the original classification. From a recent personal statement by Dr. Briggs of Teachers College I submit this passage: "The results clearly show that under such an arangement the best groups do considerably more work than the poorer ones, and that the latter, in turn, proceed without the discouragement of constant failure. For the best third of the classes one year in the three usually assigned to the junior high school is easily saved." In the sixteen years of schooling now usually provided by the combined curricula of elementary, secondary and collegiate schools, the best group could have saved three full years, thus giving them a chance to complete professional courses in the time so gained, and to begin their active life three years earlier!

Investigations in Baltimore, begun years ago under Mr. Van Sickle, point a similar lesson. Of course, a public junior high school cannot undertake too many experiments at once. It is intended for "all the children of all the people." Under no circumstance should the chief function of the junior high school

be that of a time saver. Our secondary school period is woefully short anyway. To abridge it even more would be lamentable. Richer content, clearer insight, greater appreciation, should be the goal of the junior high school, rather than a reduction of time. The danger of destroying the chief purpose of the junior high school by making it primarily an economy expedient, was clearly anticipated by Dr. J. Sachs, of Teachers College, Columbia University. In his admirable book on "The American Secondary School" (Macmillan Co., 1912), he quotes President Pritchett as saying: "The real struggle in the American higher school is between that influence which makes toward thoroughness and that which makes toward superficiality; and if the high school is to become the true training place of the people, the ideal of thoroughness must supplant the ideal of superficiality" (5th Annual Report Carnegie Foundation, 1910, p. 64). The author then continues as follows: "Fatal of course to the introduction of the six-year high-school scheme would be the assumption that with this increase in the number of high-school years the high school could blithely undertake the functions of the first two college years; we cannot protest too energetically against such an endeavor, for it would again stimulate the substitution of superficiality for thoroughness. If once it could be established that the work of the high-school stage were being done too well, then there might be a pretext for this fatuous clamor" (see p. 112, where additional references are also given).

But as soon as opportunity and experience make it feasible, it may be worth while to think of the accelerated pupil. True democracy involves the free and spontaneous development of each God-given native talent. Without differentiation a shortening of the secondary period of education is impossible, and many a fine mental endowment cannot be developed. The literature bearing on this subject, especially on practical classroom adjustments made necessary by differences in the capacity of pupils, is rapidly increasing. A brief recent summary, together with a bibliography, may be found in S. Ch. Parker's "Methods of Teaching in High Schools," Ginn & Co., 1915, pp. 362–390. Of course, Thorndike's fundamental studies of individual differences will continue to offer helpful suggestions along this line

(Thorndike, E. L., "Educational Psychology," Teachers College, 1914, Vol. III., pp. 142–388).

3. *The Community.*—In a democracy like ours no public-school issue can be considered apart from the life of the community. Our schools are supported by all the people and they must serve all the people. There is no type of school that is better adapted to render this service than the junior high school. Its differentiated courses, its departmental work, its school day, its laboratories and shops, its entire organization together offer a far more genuine educational opportunity than the ordinary grammar school.

Without doubt this fact is being recognized more and more. Not only are all the public exercises of the school well attended by our citizens, but an increasing number of out-of-town visitors furnishes evidence of the general interest in the development of the 6–3–3 plan.

Now, the work of the school could be strengthened very considerably by keeping in mind the real problems and applications suggested by the affairs of our big industrial community. This is especially true of mathematics, for again and again we must think in "quantities, proportions, forms, and relationships." Steps have been taken, with the co-operation of the chamber of commerce, to secure community data for the mathematics of the schools. A valuable beginning has been made. A number of the city departments have furnished splendid graphic material, and some of the great business concerns have contributed problems of interest. It is hoped that this work may be continued. Nothing attracts the children so much as concrete situations of a local kind. If mathematics is ever to "function" in the life of the adult, it must be accomplished through such early contact between theory and practice.

Summary and Conclusion.

How shall we reply, in conclusion, to the natural queries of the impartial critic and observer: Is the junior high school making good? And what may be done to render its future even more promising?

It is too early to give a final answer to these questions. Too many unsettled and undefined elements enter into the issue. We can judge only from the measurable features of the work of

two years. These certainly justify an optimistic spirit. The reports show that the holding power of the school is extremely gratifying, that in all departments the percentage of elimination, of failure or non-promotion means a distinct gain over former conditions.

In the mathematical classes there is definite evidence of both interest and ability to do the work. A number of pupils recently mentioned algebra as their easiest subject. If the time element can be modified as suggested above, there is little doubt that very few pupils will fail to derive both increased benefit and pleasure from this "dry" subject. Hence there is every prospect that the curriculum of the junior high school will help to solve many difficulties that have been so baffling in the upper high school.

Much remains to be done, especially in the ninth year. However, our experiments are sufficiently conclusive to warrant the compilation of a detailed course of study. This is now in preparation and in due time will be available for teachers and pupils.

The junior high school will certainly bring the world's mental and spiritual treasures nearer to the people. It will invite the young students to share the riches of the past and to become productive workers themselves. Thus it will carry its cultural mission into a multitude of homes.

As to mathematics, it will remove many an old prejudice. Perhaps it can even produce some of the enthusiasm which we find in the life of the great thinkers. In that case there will be even greater cause for the glowing outlook pictured so charmingly by one of the distinguished writers named previously:

"The golden age of mathematics—that was not the age of Euclid, it is ours. Ours is the age in which no less than six international congresses of mathematics have been held in the course of nine years. It is in our day that more than a dozen mathematical societies contain a growing membership of over two thousand men representing the centers of scientific light throughout the great culture nations of the world. It is in our time that over five hundred scientific journals are each devoted in part, while more than two score others are devoted exclusively, to the publication of mathematics. . . . It is in our time that as many as two thousand books and memoirs drop from

the mathematical press of the world in a single year, the estimated number mounting up to fifty thousand in the last generation.

"It is not, however, by such comparisons nor by statistical methods nor by any external sign whatever, but only by continued dwelling within the subtle radiance of the discipline itself, that one at length may catch the spirit and learn to estimate the abounding life of modern mathesis: oldest of the sciences, yet flourishing today as never before, not merely as a giant tree throwing out and aloft myriad branching arms in the upper regions of clearer light and plunging deeper and deeper root in the darker soil beneath, but rather as an immense mighty forest of such oaks, which, however, literally grow into each other so that by the junction and intercrescence of limb with limb and root with root and trunk with trunk the manifold wood becomes a single living organic growing whole."

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EAST HIGH SCHOOL,
ROCHESTER, N. Y.

A TENTATIVE PROGRAM OF JUNIOR HIGH-SCHOOL MATHEMATICS.*

By C. B. Walsh.

The statement is axiomatic and perhaps trite that the teaching of secondary-school mathematics is in a state of unrest. This condition has been aggravated, if not caused, by excessive criticism and this unstable state of affairs is reflected by the numerous new courses of study. It is consequently as inevitable as it is probably desirable that our curriculum in mathematics is to be reconstructed.

This reformation will be ephemeral and not worth while unless it addresses itself to the settlement of certain fundamental problems which doubtless are the worthy causes of this restlessness.

I refer to such searching queries as these:

(*a*) How shall we gain and maintain the interest of the so-called non-mathematical student?

(*b*) How shall we lessen the mortality in the mathematics courses of the ninth school year?

(*c*) How shall we enrich the practical content of our courses?

(*d*) How much mathematics shall be required of all pupils?

In part such questions must be answered by matters of method and we are not here concerned with method. Consideration of such inquiries, however, must be kept to the fore in moulding courses of study.

Problems of the type enumerated have, of course, always been of prime importance, but with the change in the character of the secondary schools they have become more insistent. Such an audience as this is so keenly aware of the nature of this change in high schools that I need lay no emphasis on the democratic trend of these institutions. Under our very eyes we

* Read at the convention of the Association of Teachers of Mathematics in the Middle States and Maryland in Trenton, N. J., April 28, 1917.

have seen the aristocrat's academy expand into everybody's school with the concomitant change in function from preparation for college to preparation for life.

The administrative adjustment to this situation has taken concrete form in the junior-senior high-school arrangement. Under this scheme the seventh, eighth and ninth school years (or junior high school) form a testing period by giving all students an extensive view of as many kinds of work as possible. Then, during the tenth, eleventh and twelfth school years (or senior high school) the survivors are offered in more intensive, elective courses, work suited to their individual needs and interests. This second stage might be termed prevocational. In a word we might refer to the junior high school as a period of opportunity and the senior high school as a period of preparation.

The motto of those of us who teach secondary school mathematics should be now, if ever, "Carpe diem." In this junior-senior high-school program we have an unparalleled opportunity to reorganize our curriculum completely and, I personally believe, in this new six-year course in mathematics a chance is given so to frame our course as to frustrate all legitimate criticism and to answer satisfactorily such problems as I presented at the outset. Obviously this cannot be done by spreading our four years' course over six, nor should it be done by bringing any of the grammar-school nor of the college mathematics as such into the secondary school course.

It does afford an opportunity to imitate the best that is in the foreign secondary-school curricula. It makes possible some such a program as Dr. D. E. Smith suggested in the MATHEMATICS TEACHER, Vol. IX., No. 2, for December, 1916. It allows us to furnish a period of testing and sampling in the junior high school, giving the student a casual acquaintance with the great phases of the subject, arithmetic, algebra and geometry, and to follow this by a period of preparation for higher work.

It is my privilege to outline for you in some detail a tentative program for junior high-school mathematics. Much of what I have to offer is a sort of report of an experiment of about four years' successful operation at the Ethical Culture School, New York City. Although we have not there a formal division into

junior and senior high schools, our subject courses have long since followed the spirit of such a formation.

The portion of the mathematics course to which I wish especially to call your attention will be clear if you will allow me first to give in outline the full six-year program.

The work of the seventh, eighth and ninth school years in mathematics is required of all students and gives an extensive view of arithmetic, algebra and geometry, intuitive and demonstrational. The curricula of the tenth, eleventh and twelfth years are elective and furnish intensive courses in college preparatory mathematics, including solid geometry, trigonometry, and a notion of analytics or calculus or business arithmetic.

Our attention at present is to be focused on the first group of these courses and whatever of profit I may be able to present will come from considering the specific details of the work of the seventh, eighth, and particularly the ninth year.

For the seventh year there is little new for me to offer as the result of our experiment, but it seems to me that this course should present two phases of the subject: (*a*) Arithmetic and (*b*) Intuitive Geometry.

At this time what might be termed "grade-school arithmetic" should be completed. When the subject was continued through the eighth year many topics were included which would now be omitted, but that merely coincides with the consensus of opinions of the teachers of the subject independent of the time element. There still remains time for reasonable drill on the mechanical side of the subject, such as the fundamental operations with integers and fractions, probably emphasizing here the decimal fraction. Further time would be afforded for simple problem work in percentage and mensuration.

Connected with and growing out of this last topic is the so-called intuitive geometry. By means of simple constructions, drawing to scale, and the like, the student at this point should gain, through his mensuration work, a familiarity with the tools, *i. e.*, names and notions, which will greatly facilitate his later work in demonstrational geometry. Let him thus preface his work in the science of the subject by the art. History and pedagogy both point to that procedure.

In the eighth year there should be an extensive course in

algebra. If you will permit me to indulge in a negative, I would add not the traditional symbol-juggling course. Remembering that this is a junior high-school required course including, therefore, future artists, carpenters, and others, with a sprinkling of college candidates, why, let me ask, should we drill these youngsters until they are professionally proficient in factoring most unusual expressions, removing ingenious nests of parentheses, simplifying a marvelous complexity of radicals?

No! Give them interesting, practical work in the subject! Let them catch the spirit of mathematics. Otherwise, wherein are we fulfilling the function of a junior high school?

Show the students that algebra is the shorthand of science. How? By the study of the formula. Show them that algebra is a tool for solving applied problems. How? By the study of the equation. Show them that mathematics has an elementary method within their grasp of representing statistics and arriving at approximate results. How? By the study of the graph. For all of this work a minimum amount of manipulation of the fundamental operations in algebra will be necessary as a means —not an end.

In our course at the Ethical School we introduce this work by a brief discussion of the historical extension of the number system until it includes negative numbers and letters. Then we apply these extensions to a study of the formula and the equation, of necessity including the work in fundamental operations in algebra, but introducing it only when needed, and using the graphic work throughout the course as one more means of expression and illustration. Through the proper selection of material for the formula work and problems resulting in the equations studied, mensuration is reviewed and extended, and much of the work formerly included in the eighth-grade arithmetic can be included from a different and, I submit, a saner point of view.

For brevity's sake, I refer you here to some notebooks (Graphisches Heft) here on exhibit, in which you will see some of the work of our pupils in connection with the study of graphs in this grade. It is our plan to have them record in this form simply one of a type of problem in graphs and such a notebook is to be kept throughout the high-school course. At the end,

then, a pupil has a cumulative reference book of his graphic work. This plan, however, seems to have been frustrated by the fact that we are no longer able to import these notebooks, but surely others are available.

Again to see what power a pupil is expected to gain in algebra through such a course, I refer you to the MATHEMATICS TEACHER, Vol. VIII., No. 3, March, 1916, pp. 145, where you will find a set of problems grouped under the four headings—"Number Systems," "Equation," "Formula," and "Fundamental Operations"—selected from the materials we use in this course. We feel that pupils who can successfully handle such problems have gained a worth-while conception and mastery of algebra as shorthand method of generalization and a tool for the solution of applied problems, although such a pupil has not acquired the finesse in manipulation of unusual complexities of symbolism, not even to the degree demanded by college entrance requirements. That accomplishment we believe to be the task of the senior high school.

The traditional course in algebra, given in the ninth school year, first of the four-year high-school course, has not proved, to put it conservatively, a great success. I base that assertion on (1) the number of failures and (2) the lack of enthusiasm for the subject on the part of the majority of survivors. Our department gave itself over to the task some years ago of reconstructing this course to overcome those difficulties and to do so in the spirit of the junior high school, *i. e.*, to furnish the maximum variety of opportunity of testing abilities and interests.

We were further impressed with the fact that whatever practical or disciplinary value mathematics had to offer these young people lay not in the abstract symbol-juggling to which algebra had largely degenerated but rather in demonstrational geometry, if it could be adapted to the age of the pupils. Of course, we thought of correlated or fused mathematics, but I venture the assertion that not only could we not formulate such a course but although I have investigated most experiments in that direction I have yet to see a fusion that was not confusion, or a correlation that was not merely an incident of method or wholly artificial. Study of the subject has quite shattered my expectation of finding such a situation, because the nature of the topics

makes it scientifically impossible. Those who argue that it is done in the Gymnasium or Lycée I refer to Professor Upton, of Teachers College, for his defense of the negative will be much more scholarly than mine.

Our solution of the problem was to give a course in demonstrational geometry with a deliberate introduction, a limited syllabus, and exercises of applied nature. I shall tax your patience to give some details of procedure under those three heads, (1) Introduction, (2) Syllabus, and (3) Exercises.

Let me preface those statements by the testimony that our experience has been that demonstrational geometry, inductively presented, made simple because scientific, is adapted to the age of pupils of the ninth school year.

The introduction to such a course should be very gradual. Familiarity with the tools of the subject might be increased by a discussion of the historic development of geometry from the art of the Egyptians to the science of the Greeks. Considerable construction work should be given. By means of numerous life-illustrations, measurements, experiments and the like the need and formation of a syllabus should be approached. Paper-folding experiments and measurements of angles by crude instruments should pave the way for the genuine scientific work. Then the first few propositions should be developed scientifically, but in a manner, though wholly convincing, yet lacking much of the rigor of form demanded later. Let matters of form grow with need. Therefore, we find it wise not to have pupils write any proofs until, let us say, four or five propositions have been developed. Then they will fall naturally into a desirable form. There is no dearth, but rather an embarrassing richness of exercises for them to write prior to this period of proof-writing. We have listed definitely some one hundred and fifty such problems.

A very important element of this course, which we call a "First Reading (or study) of Geometry," in the syllabus. It consists of only 64 propositions, covering in an extensive fashion the whole field of plane geometry. May I explain parenthetically here that those who go on with geometry beyond this course take what we term a "Second Reading" course, in which the syllabus is greatly augmented by the insertion of other

theorems. Thus we preserve the original sequence, merely placing the added propositions between others in the First Reading.

We selected the limited syllabus on three bases: (1) Propositions needed for a logical sequence. Some of the work concerning regular polygons usually found in Book V. we had to retain because needed for later proof.

(2) Theorems interesting to young people were preserved for that reason. Such a reason alone would justify the maintenance of fact like the Pythagorean relation.

(3) Propositions rich in application were retained on that basis. The area propositions illustrate this point.

You may see at once that propositions on inequality would have no place in this First Reading. Such theorems as "Square of the bisection of an angle of a triangle equals . . ." would, of course, have to go.

Then the order of the syllabus differs considerably from the traditional. Our objects in this have been to obtain a sequence of topics more *natural* than the former division into five books permitted, to get an order more psychological in that the simpler work preceded the more difficult as far as possible, and finally more pedagogical in that the interest is enlisted by bringing work rich in applications forward as early in the course as possible. This means, for instance, that following congruence with its application to parallelism, comes areas, then similarity, and then all the study of the circle growing out of locus comes last.

Finally, the selection of exercises is an important matter in this ninth year. Here we have sought to make them so far as possible applications in a variety of fields, in contradistinction to those used in the Second Study of Geometry in the senior high school where the exercises are chiefly theoretic—of the college entrance type.

Throughout pupils make and use crude instruments by which they measure heights and distances. In such instruments the lack of mechanical refinements make more patent the geometrical principles and, moreover, the less able child may make them inexpensively. I refer to such instruments as simple theodolites, astrolabes, square or diagonal scales, quadrati baculi mensorum, and the like.

An excellent discussion of a few such instruments will be found in *School Science and Mathematics,* Vol. X. (1910), pp. 48 and 126, by William E. Stark, then head of our high school. Problems suitable for solution with such instruments might be found in *Teachers College Record,* March, 1909, and in many modern texts, such as Stone-Millis, Betz-Webb, Slaught-Lennes, etc.

If I have left the impression that because this is a geometry course and not a so-called fused course, algebra is omitted, the fault is mine and not one of the course. Algebra is introduced when needed, and that is often, for example: (1) The equation is used in connection with the sum of the angles of polygons, (2) fractions are introduced in connection with areas, (3) ratio and proportion in beginning similarity and (4) the elements of the theory of exponents are taken up in the applications of the work in similarity. Here logarithms are introduced. Of course, the treatment of this topic from a theoretic standpoint is meager, for we only consider enough of the theory to make their use an intelligent one, but by introducing logarithms here the extent of the applications is greatly increased and the pupils have the use of this important tool of calculation throughout the senior high school, or if they leave school they have a valuable asset therein. Of course, the slide rule is discussed and pupils are encouraged to procure and use one when they wish and can.

In connection with similar triangles, the three trigonometric ratios of sine, cosine and tangent are studied. This topic, too, greatly extends the field of applications.

If time permitted, I should like to dwell longer on this course and point out such matters as the rewording of many traditional theorems in which particular we have not infrequently adopted the phraseology of the children, and the method of presentation of the idea of similarity by which the application to shadows, map-making, etc., is made more apparent, and the presentation of locus from the algebraic point of view. Such discussion would, however, be taking an unwarranted license with the assigned subject.

By way of a concluding summary, let me repeat that the tentative curriculum in junior high-school mathematics which I proffer for your discussion is this:

Seventh year: Arithmetic and Intuitive Geometry.
Eighth year: Algebra.
Ninth year: Geometry.

This work I submit should be required of all students and be extensive rather than intensive, in order that, in the spirit of the junior high school, it should be practical and open to the students a variety of vistas, testing thus their ability and interest. To accomplish this I should stress in the algebra the equation, the graph and formula; in the geometry I should use a limited syllabus and enrich the course through applied exercises. The testimony I bring is that such a program decidedly decreases the mortality in the subject and greatly fires the enthusiasm.

In short, I finally submit that such a program, correctly administered, answers the questions of how much mathematics shall be required of all pupils, how shall we enrich the contents of our courses, how shall we save the non-mathematical, and, moreover, such a curriculum answers the appeal of the junior high school to give to all an opportunity of finding their interest and ability.

Ethical Culture School,
New York City.

CONDITIONS WHICH HAVE LED TO THE ESTABLISHMENT OF JUNIOR HIGH SCHOOLS.

By Harrison E. Webb.

The junior high school is usually regarded as offering a solution of a very serious administrative problem in education. This problem can be properly characterized as American, as without question it arises from our ideals of freedom. It is also emphatically a *public-school* problem. Private schools have for years past so interwoven the respective curricula of public grammar schools and public high schools that in their practice these two domains of educational thought are hardly distintinguishable.

In public-school systems, however, the line of demarcation between grammar-school and high-school organization, methods, and curricula is so plainly indicated that it has seemed to many to constitute a positive obstruction to the progress of pupils. We have grammar-school "commencements" and diplomas, as well as "alumni," and every assurance is presented to the thirteen-year-old youngster that in leaving grammar school he has completed something of importance. The student entering high school is called a "freshman," and is all too often invited to look back upon his grammar-school experience with disdain. Something of the same spirit of deprecation is unfortunately too often to be found in the minds of high-school teachers, in spite of the fact that a little careful study on their part of the work of the seventh and eighth grammar grades might in some cases reveal a superiority over their own methods of procedure which would prove little short of humiliating.

The junior high-school problem has, however, its larger aspects. The break between grammar school and high school undoubtedly comes at an unfortunate time for the pupil. In many states compulsory education laws require school attendance over a period which will include for most children the first high-school year. From the expiration of that period many children

must be kept in school, if at all, by methods which are borrowed from the book of the advertising expert. A deal of psychology is involved in this, of a sort which conflicts at all too many points with the principles of sound teaching. If the child leaves school when permitted by law, the loss to the school is charged up under the discreditable caption of "mortality." If he leaves school on "graduating" from the grammar grades, his condition is regarded as normal. (Just why this distinction is made is not clear to the writer.) It appears, however, that some change which would bring into accord the legal and pedagogical limits of *fundamental schooling* would be of considerable value.

It may also be the fact, though this has not been clearly established, that the period of adolescence might well be identified with a distinct administrative period in education.

A still larger problem, which is especially pertinent at the present time, is presented as the educational aspect of the eternal conflict of art and democracy, of efficiency and freedom. Our American tradition has at its base the doctrine, regarded as hopelessly false in many high places, that any child may be brought to do almost anything if properly taught. This prevailing sentiment contributes liberally to our list of failures, for reasons hardly necessary to state. Suffice it to say that the teacher who endeavors to direct the failures in his classes into channels which to him seem better suited to their natural aptitudes is too often regarded as endeavoring to conceal his own shortcomings.

The continental (European) ideal, on the other hand, has been to take full cognizance of these aptitudes of children, to stress them heavily in the educational process, and even to invent them when they are not perceptible. The school, in a word, is expected to make the child fit somewhere into the organization of society, and some higher power gives the final word as to how this shall be done. Errors in particular instances are overlooked, in favor of the well being of the whole state.

It is currently believed (or it was until the outbreak of the war) that the actual working out of this ideal in Europe resulted in an economy of at least two years in the educational process, as compared with our own order; this may be true, but the false conclusion has often been drawn that two years were

thus added to the maturity of a child of given age. Allowance should be made, moreover, for the fact that the English language, as at present constituted, contains so many horrible absurdities of spelling, pronunciation, and usage that a normal child might reasonably be expected to require for its mastery at least two years more than his European brother needs to acquire a like facility in the use of his native tongue. Our standards of physical measurement, too, are equally absurd and difficult of presentation. In the field of history also, it is necessary for American students to gain a fair knowledge, not only of America, but of the whole world; whereas in Germany and elsewhere, it appears, it has been felt that American history and its moral lessons might safely be disregarded.

All of which may well give us pause to consider whether those two years can really be saved at all in American schools. As an illogical result of our present political status, that slavish worship of German models, which has for a quarter century past characterized our educational theory, may be abruptly abandoned. Let us, as teachers, make it our high duty to substitute therefor a proper respect for the best in German educational thought, combined with the conviction that, as American teachers, we must work out our own salvation in our own way.

These administrative matters are, I fear, only too well known to all; but they will bear recapitulation.

Another factor, and a more potent one, which has given rise to the present-day demand for the junior high school or its equivalent, is the overcrowding of the secondary curriculum. It is a lamentable fact that at the present time we are endeavoring to crowd into the minds of our pupils much more than their brains can hold. This is partly due to the increased demands of American colleges, particularly in the field of mathematics, where they are worse than the proverbial daughters of the horseleech. It is also due directly to the vast increase in the sum of human knowledge during the past half century—so great as to be almost immeasurable. There is another matter also to which particular attention should be directed.

In 1898 the famous report of the Committee of Ten led the way to the extension of the time devoted to required work in high-school English from three months to four years. At the

same time the classical or foreign language requirement was abated only slightly; the mathematical requirement was increased by the addition of several topics in algebra and an enormously increased emphasis upon original exercises in plane geometry; and courses in science which can properly be termed scientific, and are by so much the more difficult, were substituted for the forty weeks of this or that of the older order. The net result is, in the humble opinion of the writer, that only the exceptional student can be expected to attain the standards which are set for all; and that the greatly improved teaching methods of to-day, as compared with those of thirty years ago, are wasted upon an attempt to achieve the impossible. The result has been a lowering of standards and a weakening of intellectual discipline all along the line. It is greatly to be doubted if the junior high school will correct this error. The better solution is a much simpler one—the reduction of the college requirement to a single foreign language, ancient or modern. Four years at least of a modern foreign language are essential to any facility in its use. And four years of an ancient language should be ample as a substitute for this in the case of students whose college work is to lie in the field of the classics. Until this is done, mathematics, in its broader cultural and useful aspects, can hardly be expected to take its true place in high-school curricula. Until the polyglot ideal is definitely abandoned, with its train of exclusiveness and superficiality, it is doubtful if that earnestness, sincerity, and assurance which are so characteristic of mathematical study can ever make their mark upon the collective intellect of our student body. There is little likelihood that the junior high school, by extending the high-school course downward into two more years of immaturity, can obviate the necessity of this modification.

Until this can be done, it becomes our duty to unify the mathematical instruction of grammar school, high school, and college as perfectly as possible. In fulfilling this duty, much remains to be done. Most important of all, perhaps, is the thorough grounding of high-school teachers in the fundamental principles of arithmetic. It is safe to say that only the more recent graduates of larger universities enter the teaching profession with this equipment. For the rest of us arithmetic is a dim memory of childhood's happy hours.

Now arithmetic has its generalizations, as well as algebra and geometry. Arithmetic differs from algebra chiefly in that these generalizations are presented explicitly. Algebra, on the other hand, employs the symbolism of literal expression, and by so doing makes more clear the essential steps in inverted processes, and so leads the way to a study of types of equation and to infinite series. Geometry employs the symbolism of physical extent, and so broadens the number field enormously, and permits of the drawing of conclusions from an extended list of theorems.

It is a fact, however, that many of the explicit generalizations of arithmetic are very difficult of comprehension, in spite of their palpable usefulness in practice. At present many of these principles are lost sight of as a result of dissociating grammar-school arithmetic and secondary-school algebra. The grammar-school "graduate" must be prepared to employ a few simple arithmetical processes with ease and accuracy. The high-school "freshman" requires considerable time and attention in order that he may in a few weeks become thoroughly familiarized with a new symbolic notation. By this procedure progressive standards of intricacy of process have gradually come to be substituted for the mastery of fundamental principles as the aim of the secondary algebra course. And when these standards have been attained, it is the established custom to send the pupils careering through the refinements of Euclidean logic, with little or no emphasis upon the mathematical or practical content of a proper course in geometry.

It would appear, though the statement requires substantiation, that at present an excessive amount of time is devoted in grammar schools to relatively simple arithmetical operations, and that the purposes of thorough drill are defeated through excessive iteration. Arithmetic has changed from a hard subject into a tiresome one. Accuracy, the universal demand of employers and others, can be inculcated to some extent by continued drill and repetition. But it is also functioned by discipline, and it may well be questioned whether the decreased content, with consequent repetitions, of grammar school arithmetic has not come about as a result of the relaxed intellectual discipline which follows naturally from the application of "development methods" in primary education.

The junior high-school course of two or three years, so arranged as to include the customary first year of algebra, will meet this situation, provided some method is devised by grammar-school authorities for improvement in accuracy in the first six grades. If this is well done, the seventh, eighth, and ninth years should be devoted to generalized mathematics, and should include the *principles* of arithmetic, symbolic form of expression, "informal" geometry, elementary equations and problems, and a wide field of applications. The junior high-school mathematical course should be a unit in itself. Probably it will not be practicable to crowd into it matter which is now given in the last three years of the high-school course. It offers no place for Euclidean method. Theorems and corollaries should be taboo. Much that is now presented in "first-year algebra" may of necessity be postponed to the senior high school, or omitted entirely. But the way is open in the junior high school to make mathematics an interesting and vital factor in elementary education.

It is desirable also to consider at this time the possibility of establishing a continuity of subject matter during the seventh, eighth and ninth years, even when local conditions interfere with the establishment of junior high schools as educational units. It should be practicable in a large city system for eighth-grade teachers and high-school teachers to reach a common interest in this field through conferences, supervision, and the arrangement of suitable curricula.

In considering the junior high-school mathematical course, administrative authorities should bear constantly in mind its experimental character, and allow considerable latitude to teachers in carrying out any organized plan.

CENTRAL HIGH SCHOOL,
NEWARK, N. J.

JUNIOR HIGH-SCHOOL MATHEMATICS IN TRENTON.

By Louise Northwood.

The junior school movement in mathematics, as we see it in Trenton, emphasizes the necessity for, first, a much more simple program below the seventh grade, second, more thorough drill in fundamentals and third, definite testing to determine results.

To meet this we have aimed to make our work less inclusive and more intensive. Up to date the work has been largely experimental. We are at present working on a course of what we call mimimal essentials and with that as a framework we will build what we hope will be that which we need.

As you well know we have three grades, seventh, eighth, and ninth, to consider and also a further division because of ultimate aims of pupils in each grade. Differentiation we must have, for we want to consider very definitely the needs of that child who must leave early and take his place in the industrial world and, from a different angle, to consider the one who knows college awaits him beyond high school. A constant question in our mind has been, "Just what does each child need?" We do not in any sense feel we have entirely solved the problem, but of this we are sure, both groups must be accurate and have ability to do with as much speed as possible the four fundamentals, fractions and decimals. Business men tell us there is very little beyond this of absolute necessity.

On the day school opened, October 30, we gave to every child in the school an arithmetic test including five examples in each of the fundamentals, setting as a time limit forty minutes. From these papers we saw a dire need for drill on fundamentals.

To meet this need we divide our period of one hour into three distinct parts and devote the first ten minutes to some form of drill. The form varies from day to day. One form, which we feel has been exceedingly valuable, is a series of rapid calculation charts on the four fundamentals which we

prepared and had printed. Some charts have all the fundamentals, while others are devoted to one enabling us to meet the need of each individual. The children are most enthusiastic over these and vie with each other and with other classes to get the greatest number of hundreds on a given day.

We use also the mathematical relay race, oral drill and board drill.

After giving these drills from November to February, we gave to all classes the same test given the first day and some classes raised their class average as much as 38 per cent. Every class showed a vast improvement.

Drill then of some type occupies the first ten minutes of every period. The next fifteen minutes are usually devoted to recitation or explanation. Here we give our development lessons or hear classes recite prepared lessons. For the last thirty-five minutes the pupils work at their desks on assigned work to fix that which has been developed. During this time the teacher goes around and helps where help is needed and works with the children as individuals.

I said above that we were working on a definite outline of minimal essentials. As soon as we get what we feel is a fairly complete outline we are planning to attempt to standardize processes along as many lines as possible and then introduce drill exercises to fix each with a hope that it may become as much a part of the child as the multiplication table.

We will use in this standardizing as many short methods as possible for we feel time-saving devices are valuable.

As soon, then, as our working scheme for this part is completed we will attack the problem situation. We are hoping to be able to produce a need in the life of the child and then let the problem work out from that need. Our seventh-grade problems we are building around the home and the eighth-grade around the community.

We are not aiming however to use this phase entirely, for we firmly believe a child can become interested, and needs as well, some work beyond the purely practical. The joy of conquest in the problem world is a large factor in the pupil's intellectual life and must not be overlooked. Moreover not every task in life is a pleasant one and why should all in school be?

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To further enrich our course and to develop more thoroughly the mathematical sense we will introduce more extensively next year the equation, formula and some inventional geometry, as well as an extensive use of graphs.

In the ninth grade we have three distinct courses to correspond with the courses pursued in the school, the academic, practical arts and commercial.

The academic work is practically the same for girls and boys and covers the first year of algebra as planned in most high schools. We have used this year a set of charts in algebra which we have prepared for drill work. These mimimal charts are sixteen in number at present and cover the mimimal essentials of algebra. We have aimed to make them so inclusive that we may say when a child has passed all successfully he has at his command the minimum amount of knowledge of the subject and is ready for the sophomore year. These serve as a test to measure the child more definitely, we feel, than the monthly, weekly or topical tests. Here too, all children of all teachers get the same test and it is a better measure for comparative purposes.

The practical arts group includes those pupils who work better with their hands or who will probably leave before completing a full high-school course.

In this group the work for boys and girls is radically different. For both however the time is equally divided between algebra and arithmetic, giving two days a week to each.

The shop work is strongly emphasized. The girls have been making hats and dresses in the shops and they figure to a nicety just how much material they will need, what width is most economical and what kind is best.

In the cooking department the children prepare lunches for the teachers each day and the actual costs are computed by the mathematical department. Problems arising in connection with the buying of materials in both departments are given extensively. They figure costs of meals served in their homes, the number of ounces of protein or carbohydrates, etc., in certain foods and then graph results. Many original problems are made and solved by the girls. The general aim has been to make them able to handle easily the mathematical problems that might arise in the home or shop to which they may go.

The boys of this group have used the mathematics in the general problems of housebuilding as excavating, flooring, the fitting of rafters, joists and sills, the placing of staircases, roofing, plastering, etc. After dealing with each topic the teacher gave as a final problem the drawing of the plan and the computing of the cost of an entire house. The algebra in this group for both girls and boys has treated more practically the equation, formula, and graphs, the idea being to give a background for the algebra of investments which is planned for the senior year for those who stay for a full course or to give those parts of algebra most useful in shops for those who leave to enter the industrial world.

In the commercial department are those who are planning to enter the commercial world. Here, again, the general aim is accuracy and speed. Short methods as applied to business are strongly emphasized. Much work is given in making and reading graphs. Those phases of arithmetic which serve as a foundation for the regular commercial arithmetic are emphasized. Some algebra is given to these students also.

These then are some of the plans of our work but we say again it is still largely experimental and we do not offer it in any sense as a perfected course.

TRENTON HIGH SCHOOL,
TRENTON, N. J.

A CONNECTION BETWEEN ALGEBRA AND LIFE.

By Elizabeth G. White.

Can algebra be made a vital subject of real value to every student? Can it be made an instrument to prepare each student for his life problems? Questions like these must confront every teacher who is not so blinded by the glittering generalities of formal discipline that he can not see the issues that count. The task seems hopeless when one turns to the pages of a standard textbook and finds such questions as the following: "Three times the excess of a certain number over eight is equal to twice the number plus one. Find the number." Of what possible interest is such a problem? What connection can its solution have with any of the life situations the student will meet? A buoyant teacher may infuse into it an interest; by the force of her personality she may keep it from seeming the dry bones that it really is. A better type of question perhaps is the following, but it failed to arouse any interest in the class to which it was presented: "At an election there were two candidates and 1,280 votes were cast. The successful candidate had a majority of 40. How many votes were cast for each candidate?" This question was given to a class of first-year high-school students in the fall of the present year when the approaching presidential election was a matter of interest. As the teacher turned to this question in her textbook she thought, "Here is a problem within the experience of my students." The girl who was asked to solve it read it five times and then had no idea of the equation. When asked why she could not do it, she said, "I don't know anything about voting." That was the point, she knew nothing about voting, and there was no connection in her mind between the problem and current events which could arouse a desire to know.

On November 7, 1916, a first-year class came to its algebra room; there was suppressed excitement in the air, the feverish interest that permeated the American body politic had pene-

trated into this class room. The teacher put the following question on the blackboard, the data for which she had acquired at the noon lunch hour by phoning a downtown office:

"At noon to-day Mr. Hughes had three less electoral votes than Mr. Wilson. If there were 42 votes still to be heard from, how many votes had each candidate at that hour?"

When told that the answer to the problem would give the actual returns at noon, the class fell upon it, each eager to know the chances of her candidate. Some students did not know the total number of electoral votes; the correct number, 531, was supplied by a student and the problem was soon solved by the class. The teacher then made a question which was not based on actual facts; she trusted to the interest already aroused to carry it through, and was not disappointed. The question was as follows:

At 12 o'clock midnight on November 7, 1916, Mr. Hughes had 6/5 as many electoral votes as Mr. Wilson. At 1 A. M. each received 10 more votes, at 2 A. M. Hughes received 6 and Wilson 7, at 4 A. M. Hughes received 2 and Wilson 10, and at 5 A. M. Hughes received the remaining votes, which were 35. How many votes had each candidate at midnight?

The point in algebraic manipulation which the class lesson aimed to give was the method of handling a fractional equation. Most members of the class solved the last problem by letting $6x =$ number of votes Hughes had, and $5x =$ number of votes Wilson had. The teacher asked for a fractional expression, and received the statement,

Let $x =$ number of votes Wilson had, and

$\frac{6x}{5} =$ number of votes Hughes had.

This introduced the fractional equation which is handled by the axiom "If equals are multiplied by equals the products are equal." The remainder of the class lesson was spent in solving problems involving fractional equations, which were found in the textbook, and the home work assignment consisted of problems of the same character.

On the following day students were asked to make some problems on the election returns. November 8 was the day, and students were eagerly waiting for returns, as were all Ameri-

cans. In a few minutes six or seven problems were ready. The following are some of the problems made by the students:

1. On November 9, 1916, the morning papers showed that Woodrow Wilson had 12 electoral votes more than Charles Hughes. If 41 electoral votes had not been accounted for, how many votes had each of the candidates on that morning?

2. In an election Mr. Wilson has 4/5 as many electoral votes as Mr. Hughes. If Hughes should get 48 more electoral votes he would have twice as many as Mr. Wilson. How many votes has each?

3. On November 8, 1916, the evening paper said that Woodrow Wilson had 21 more votes than Charles Hughes. If 20 electoral votes had not been counted, how many had each of the candidates on that night, the total amount of electoral votes being 531.

4. On November 8, 1916, the papers showed that Mr. Wilson had 6/5 as many votes as Mr. Hughes. If one hour later Mr. Wilson receives 20 votes and Mr. Hughes 15, 45 not being accounted for, how many votes did they each have that morning?

5. On November 8, 1916, Mr. Wilson had 10 more electoral votes than Mr. Hughes. If 39 electoral votes had not been accounted for, how many votes had each?

6. On November 9, 1916, papers showed that Mr. Hughes received 30 more votes than Mr. Wilson. If 5 votes had not been cast yet how many votes has each now?

One student had brought data concerning the states not heard from. She wrote out the following problem which she gave to the class in a most delightful manner:

This morning's paper says that Wilson has 12 more electoral votes than Hughes. At 10 A. M. Wilson carries California, which has 13 electoral votes, and, at the same time, Hughes carries Minnesota, which has 12 electoral votes. At 11 A. M. Wilson carries North Dakota, which has 5 electoral votes, and New Mexico, which has 3. At 12 noon Hughes carries West Virginia, which has 8 electoral votes. If this completes the returns, how many electoral votes did each candidate have before the returns from these five states came in? After the returns from these five states came in?

This question showed very clearly where her interest in the

election lay. The five states not heard from she handled in such a way that her candidate would be successful. When she came to the statement that West Virginia had gone for Hughes, she turned to the teacher and confidentially said, "I am sure West Virginia will go Republican." Thereupon others in the class expressed a similar opinion. Algebra, remote, abstract algebra, had become connected with life, with the very heart life of the American people, and its signs and symbols were used to solve that most interesting of all problems, "Who is elected?"

Since questions of current interest when made by students are easily solved, a certain method of handling them is necessary in order that definite aims may be accomplished. The aims of such a lesson are:

1. To place the work within the experience of the student, thus furnishing a basis for interest.
2. To furnish a natural starting point for more difficult problems, with their necessary mechanical manipulation.
3. To arouse student initiative in making problems.
4. To give facility in translating rapidly and correctly the words of a problem into the symbols of an algebraic equation.

This last aim is accomplished by what is known as a "Problem Game." In playing this game a student reads, clearly and slowly, a problem she has made, while the class immediately writes the equation which will express the facts given. The class does not copy the words of the problem, but writes the algebraic symbols which stand for the words, just as a stenographer writes shorthand from dictation. The problems are usually simple enough to permit of this rapid translation. Every student in the class must be ready with a problem in order to play the game; a student forfeits three points when she cannot respond when called on. The aim is accomplished by this very act of making a problem. Making a problem is like getting on the inside and looking out. The mysterious man who makes textbooks has been forcing his problems upon the innocent student ever since he took his first arithmetic book in hand. Here is a different viewpoint, the student now has a chance to get back of the scenes, to juggle the symbols

himself and turn out something worth solving. The algebraic processes and symbols become more familiar when handled from this viewpoint.

The Problem Game may be briefly described as follows:

Rules for the Problem Game.

1. Teacher chooses student to read a problem which student has made.

2. Class and teacher write the equation at their desks as the student reads her problem to them, just as a stenographer writes shorthand from dictation.

3. The student who first finishes the problem refers it to the teacher, and if it is correct her name is placed on the score board with the mark (2).

4. This student then becomes the time-keeper.

5. The students solving the problem correctly within the next two minutes place their names on the score board with the mark (1).

6. If a student makes a problem incorrectly she receives the mark (—1).

7. The student first arriving at the correct solution calls upon another student to read the next problem, thus the game is thrown into the hands of the students. The teacher's part is to see if the problems are correctly made and solved.

Score of Problem Game Played by Students of a First-Year Algebra Class, November 10, 1916.

Name of student making problem 1: Ray Zest (2).

Name of student first correctly solving problem 1: Grace Stack (2).

Names of students solving problem 1 correctly within next two min.: Regina Stack (1), Bertha Wyner (1), Phyllis Tyrrill (1), Mae Shockey (1), Dorothy Shockett (1), Lydia Zollenhofer (1), Margaret Witters (1), Cordelia White (1), Christina Seitz (1).

Names of students making problem II:

Christina Seitz (−1).
Dorothy Shocket (−1).
Irene Slaysman (+2).

Name of student first solving problem II: Bertha Wyner (2).
Names of students solving problem II correctly within the next two minutes:

Grace Stack (1),
Dorothy Webster (1),
Cordelia White (1),
Mae Shockey (1),
Margaret Witters (1),
Ray Zest (1),
Adele Seitz (1),
Marian Slaysman (1),
Esther Wiley (1),
Margaret Albert (1).

Names of students making highest score on the two problems:

Ray Zest (3).
Bertha Wyner (3).
Grace Stack (3).

EASTERN HIGH SCHOOL,
BALTIMORE, MD.

SUGGESTIONS BY THE COMMISSIONER OF EDUCATION.

(From Bureau of Education Circular of May 22, 1917.)

The United States has entered into the war to the end that its own democracy shall be safeguarded and that government of the people, by the people, and for the people may prevail over all the world. But democracy requires for success universal knowledge, intelligence, and virtue of high degree, and must protect itself from weakness and corruption from within no less than from forceful invasion from without. Therefore, it is of the utmost importance that during the continuance of the war and through the years immediately following there shall be no lowering in the efficiency of our systems of education. Schools and other agencies of education must be maintained at whatever necessary cost and against all hurtful interference with their regular work except as may be necessary for the national defense, which is of course our immediate task and must be kept constantly in mind and have right of way everywhere and at all times. From the beginning of our participation in the war we should avoid the mistakes which some other countries have made to their hurt and which they are now trying to correct.

If the war should be long and severe, there will be great need in its later days for many young men and women of scientific knowledge, training, and skill; and it may then be much more difficult than it is now to support our schools, to spare our children and youth from other service and to permit them to attend school. Therefore no school should close its doors now or shorten its term unnecessarily. All young men and women in college should remain and use their time to the very best advantage, except such as may find it necessary to leave for immediate profitable employment in some productive occupation or for the acceptance of some position in some branch of the military service, which position can not be so well filled by anyone

else. All children in the elementary schools and as nearly as possible all high-school pupils should remain in school through the entire session.

When the war is over, whether within a few months or after many years, there will be such demands upon this country for men and women of scientific knowledge, technical skill, and general culture as have never before come to any country. The world must be rebuilt. This country must play a far more important part than it has in the past in agriculture, manufacturing and commerce, and also in the things of cultural life—art, literature, music, scientific discovery.

Russia and China are awakening to new life and are on the eve of great industrial development. They will ask of us steel, engines, and cars for railroads, agricultural implements, and machinery for industrial plants. They will also ask for men to install these and to direct much of their development in every line. England, France, Italy, and the central Empires have thrown into battle a very large per cent. of their educated and trained men, including most of the young professors and instructors in their universities, colleges, gymnasien, lycées, and public schools. Their colleges and universities are almost empty. The young men who would under normal conditions be receiving the education and training necessary to prepare them for leadership in the future development of these countries are fighting and dying in the trenches. All these countries must needs go through a long period of reconstruction, industrially and in many other respects. Our own trained men and women should be able and ready to render every possible assistance. It should be remembered that the number of students in our universities, colleges, normal schools, and technical schools is very small as compared with the total number of persons of producing age—little more than one half of 1 per cent. The majority of these students are young men and women who are becoming more mature and fit for service. The older of the 60,000,000 men and women of producing age are growing more unfit and are passing beyond the age of service. It should also be remembered that the more mature the young men who volunteer for service in the Army the more valuable their services will be. The age of selective draft is from 21 to 30.

Therefore a right conception of patriotism should induce all students who can not render some immediate service of great value to remain in college, concentrate their energies on their college work, and thus be all the more ready and fit when their services may be needed either for war or for the important work of reconstruction and development in our own and other countries when the war shall have ended.

Fortunately it is possible for all schools to continue for the present at least in their full educational efficiency and with little or no diminution in their attendance, and at the same time contribute much to the national defense.

For the purpose of promoting the ends herein set forth the following suggestions are offered for an educational program during the war:

General.

All schools of whatever grade should remain open with their full quota of officers and teachers. The salaries of teachers should not be lowered in this time of unusual high cost of living. When possible, salaries should be increased in proportion to the services rendered. Since the people will be taxed heavily by the Federal Government for the payment of the expenses of the war, teachers should be willing to continue to do their work, and do it as well as they can, as a patriotic service even if their salaries can not now be increased. All equipment necessary for the best use of the time of teachers and students should be provided, as should all necessary increase of room, but costly building should not be undertaken now while the prices of building material are excessively high and while there are urgent and unfilled demands for labor in industries pertaining directly and immediately to the national defense. Schools should be continued in full efficiency, but in most instances costly building may well be postponed.

During school hours and out of school, on mornings, afternoons, Saturdays, and during vacation all older children and youth should be encouraged and directed to do as much useful productive work as they can without interfering with their more important school duties. This productive work should be so directed as to give it the highest possible value, both economic-

ally and educationally. For children and youth in schools of all grades there will be need of more effective moral training, and provision should be made for this. While the war for the safety of democracy is in progress and when it is over there will be greater need for effective machinery for the promotion of intelligent discussion of the principles of democracy and all that pertains to the public welfare of local communities, counties, States, and the Nation. To this end every schoolhouse should be made a community center and civic forum with frequent meetings for the discussion of matters of public interest and for social intercourse. The Bureau of Education will give advice in regard to this upon request.

I. Elementary Schools.

Except in case of great need, attendance laws should be enforced as usual. Parents should be encouraged to make all possible efforts to keep their children in school and should have public or private help when they can not do so without it. Many young children will lack the home care given them in times of peace, and there will be need of many more kindergartens and Montessori schools than we now have. Much might be gained by keeping the elementary schools open all the year with such changes in study and daily regimen as may be necessary to adapt the schools to the changes of the season. A school year of four terms of 12 weeks each is suggested. Home gardening and other useful occupations should be encouraged and when possible should be directed by the school. In country and village schools boys and girls should be encouraged to join corn clubs, canning clubs, poultry clubs, and other similar clubs for the production and conservation of foods. These clubs should be directed by teachers with the help of farm-demonstration agents and other employees of agricultural colleges and departments of agriculture of States and the Federal Government. In the South boys and girls should be encouraged to grow peas, peanuts, sweet potatoes, beets, turnips, onions, and other root and bulb crops. In city schools wholesome school lunches should be provided at cost and should be given without price when necessary. Girls in the higher grades should be directed in making clothing for smaller children who will need the help.

Teachers should consult local charity associations as to what assistance can be given them through the schools.

II. High Schools.

The attendance in the high schools should be increased, and more boys and girls should be induced to remain until their course is completed. A school year of four terms of 12 weeks each is recommended for the high schools, as for the elementary schools. In the high schools adopting this plan arrangements should be made for half-time attendance, according to the Fitchburg, Cincinnati, and Spartanburg, S. C., plans, for as large a proportion of pupils as possible. In all high schools more attention should be given to chemistry, physics, biology, and to industrial, social, and civic subjects. Where possible, high schools should remain open this summer and give intensive work in the sciences, in manual training, domestic science and arts, and in trades and industries. Many boys might thus be fitted for engineering and agricultural courses in college a year earlier than they otherwise would be, and girls might be fitted to enter college a year earlier for courses in home economics. All laboratories and manual-training shops in high schools should be run at their full capacity. In many of the shops work should be done which will have immediate value for the national defense. The Bureau of Education, the Department of War, or the National Council of Defense can give information in regard to what can be done.

In all high schools in which domestic science (sewing, cooking, sanitation, etc.) is taught, large units of time should be given in the summer and fall to sewing for the Red Cross and for local charities. There will be much suffering next winter in all our larger cities. Charity associations and relief societies will need all the help they can get. Hundreds of thousands of garments should be made in the public and private high schools during the summer and fall. Local chapters of the Red Cross can give information as to its needs. Classes for grown-up women should be formed in which practical instruction can be given largely by lecture and demonstration in the conservation and economic use of food. These classes should meet at such times as may be most convenient for the women, and all women

who have to do with housekeeping or home making should be encouraged to attend them. In country and village high schools in which agriculture and domestic science are taught, boys and girls should be encouraged to undertake home projects under the direction of their teachers, after the Massachusetts plan, and classes meeting once a week or oftener should be formed for the women of the community for instruction in the preservation of foods, sanitation, and economic housekeeping.

III. Continuation Schools and Evening Schools.

For all boys and girls who can not attend the day sessions of the high schools, continuation classes should be formed, to meet at such times as may be arranged during working hours or in the evening. All cities should maintain evening schools for adult men and women. In cities having considerable numbers of immigrants, evening schools should be maintained for them with classes in English, in civics, and such other subjects as will be helpful to these foreigners in understanding our industrial, social, civic, and political life. For instruction in trades and industries and for continuation schools, the funds provided by the Federal vocational educational law, the so-called Smith-Hughes Act, may be used.

IV. Normal Schools.

In few States is the supply of broadly educated and well-trained teachers equal to the demand. In some States the normal schools do not yet prepare half enough teachers to fill the vacancies. The need for better schools to meet the new demands for a higher level of average intelligence, scientific knowledge, and industrial skill, which will come with the reestablishment of peace, makes more urgent the need for more and better trained teachers. Every dollar expended for education and every day of every child in school must be made to produce the fullest possible returns. The normal schools should double their energies and use all their funds in the most economic way for the work of preparing teachers. Appropriations for the support of normal schools should be largely increased, as should also the attendance of men and women preparing for

service as teachers. Many of these schools now have summer sessions and adapt their work to the needs and convenience of their students, and especially of teachers already in the service who wish to use their vacations in further preparation. All normal schools that do not do this now should at once make arrangements to do it. Such normal schools as have well-equipped departments of domestic science or home economics should this summer offer special courses for teachers and other women who are willing to form classes in domestic science and arts at the rural and village schools for the women of the communities in which the schools are located.

V. Colleges, Universities, and Technical Schools.

It is to be expected that many of the older and upper class men in colleges, universities, and technical schools will volunteer for some branch of the military service, but all young men below the age of liability to selective draft and those not recommended for special service should be urged to remain and take full advantage of the opportunities offered by the colleges, universities, and technical schools, to the end that they may be able to render the most effective service in the later years of the war and the times of need that will follow. Practically all women students should remain, and all boys and girls graduating from high schools should be urged to enter college, technical school, or normal school. The total number of students in these schools should be increased rather than diminished. All students should be made to understand that it is their duty to give to their country and to the world the best and fullest possible measure of service, and that both will need more than they will get of that high type of service which only men and women of the best education and training can give. Patriotism and the desire to serve humanity may require of these young men and women the exercise of that very high type of self-restraint that will keep them to their tasks of preparation until the time comes when they can render service which can not be rendered by others.

All institutions of higher learning should reduce the cost of living and all other expenses to the lowest possible figure so that the fewest possible number may be excluded because of the

cost of attendance. The instructors of the institutions themselves, societies, and individuals should lend to worthy students at low rates of interest and on as long terms as may be necessary funds needed to keep them in college until graduation. To do so may prove to be a most effective means of patriotic service. Calendars of colleges, universities, and technical schools should be so modified as to enable them to use their plants most fully and to meet most effectively the needs of their students. It is probable that for many the school year of four quarters of 12 weeks each will prove most useful. For others, summer courses with special emphasis on engineering and other technical and professional courses may be best. Quite certainly, all these institutions should give every possible opportunity for intensive instruction in these subjects and in chemistry, physics, biology, and their practical, productive applications. Full use should be made of all laboratories and shops, whether for teaching and demonstration or for research. In many of them much productive work might be done for the immediate service of the country. The Department of War and of the Navy, the American Red Cross, the National Council of Defense, and the Bureau of Education will be able to make suggestions in regard to this from time to time. In their summer quarters or summer schools all of these institutions that have departments or schools of home economics should give special, intensive courses for teachers and other women who are willing to organize, next fall and winter, classes of women who are housekeepers and home makers in country, village, and city, and instruct them in the conservation and economic use of foods and in the most practical principles and methods of home economics.

In agricultural colleges special intensive courses should be given to prepare teachers, directors, and supervisors of agriculture and practical farm superintendents. It should be remembered that the scientific knowledge and the supervising and directing skill of these men and their ability to increase the productive capacity of thousands of men of less knowledge and skill are far more valuable than the work they can do as farm hands. The total number of agricultural students in all colleges is only a fraction more than one tenth of 1 per cent. of the total number of persons engaged in agriculture, or about

13 in 10,000—not enough to affect materially the agricultural production of the country by their labor, but enough to affect it immensely by their directive power when their college courses have been finished. All State universities and colleges of agriculture and mechanic arts, and all other institutions that do extension work, should prepare themselves to render still more effective service in this direction. There will be need for it. No college, university, or technical school that can avoid it should permit its faculty or student body to be scattered or its energy to be dissipated. All should redouble their energies and concentrate them on those things that will be of most service during the progress of the war and which will prepare their students for the most effective service of the country and of the world when the war is over.

The desire to render immediate service is praiseworthy, and the spirit which prompts it should be fostered, but it is effective service that finally counts. Schools and shool officers, teachers, and students should ever keep this goal of effective service in mind.

NEW BOOKS.

Bugle Calls of Liberty. By GERTRUDE VAN DUYN SOUTHWORTH and PAUL M. PAINE. Syracuse: Iroquois Publishing Co. Pp. x + 179.

This collection of the great speeches and inspiring poems of United States history would be a valuable supplementary reader at any time, but it is especially timely now. It starts with Patrick Henry in 1775 and ends with President Wilson and Robert Lansing in 1917. The contents are well chosen, and should find many uses in school work.

Number Games for Primary Grades. By ADA VAN STONE HARRIS and LILLIAN MCLEAN WALDO. Chicago: Beckley-Cardy Co. Pp. 118. Price 60 cents.

It has been so clearly established that interest plays an important part in improving the work in arithmetic, that primary teachers will welcome this excellent book on simple number games. The lower grades are losing their formality, fortunately for the children, and such helps as this will make it easier for the teacher to connect the desired freedom with the necessary drill. The book contains fifty-eight games suited for children of different ages.

Nixie Bunny in Faraway Lands. By JOSEPH C. SINDELAR. Chicago: Beckley-Cardy Co. Pp. 160. Price 45 cents.

This is the fourth of the Nixie Bunny series. It is not only an interesting story, well illustrated, but it weaves in a great deal of information in a way that children can easily grasp. It should prove a valuable supplementary reader.

New Common Sense Song Book. By LAURA ROUNTREE SMITH, ARTHUR SCHUCKAI, CLARK LEARNING, CLARENCE L. RIEGE, and ANNA H. HAMILTON. Chicago: Beckley-Cardy Co. Pp. 174. Price 40 cents.

This is a one-book course in music for schools of mixed grades. It starts with twenty lessons in the first principles of music, then progresses through rote songs, primary melodies and childhood songs to the more difficult music suitable for various purposes, such as special days, patriotic occasions, etc. While there are plenty of the old songs that should be in such a collection, there is also a good deal of new music, much of it by the authors of the book.

An Experiment in the Fundamentals. By CYRUS D. MEAD. Yonkers-on-Hudson, N. Y.: World Book Company. Pp. xiv + 54. Price 60 cents.

This book is one of the School Efficiency Monographs. It reports the results of tests made in Cincinnati with the Courtis Practice Tests and Thompson's Minimum Essentials. The experiment was a very interesting one, and the report is clear and well arranged. It will prove of interest to all who have responsibility for courses in arithmetic.

Arithmetic Tests and Studies in the Psychology of Arithmetic. By GEORGE S. COUNTS. Chicago: The University of Chicago Press. Pp. iv + 125. Price 75 cents + postage.

The tests used in this study were developed for the use of the Cleveland Survey. They are designed to indicate specific weakness in the fundamental operations with integers and fractions. By graduated series of tests in each operation they show ability to "carry," to bridge "attention spans," etc., in a way not done by the single series of Courtis Tests.

Standard Scores for Grades 3–8 are given, obtained from Cleveland and Grand Rapids pupils, and considerable attention is paid to the diagnosing of individual, class, school, and city weakness. Types of Errors are also analyzed, and many valuable facts are brought out in regard to them.

An interesting feature is the comparison of certain race groups, and of certain age and promotion groups.

This is an important contribution to experimental education, and should have wide circulation.

Third-Year Mathematics for Secondary Schools. By ERNST R. BRESLICH. Chicago: The University of Chicago Press. Pp. 369 + xviii. Price one dollar + postage.

Logarithmic and Trigonometric Tables and Mathematical Formulas (to accompany the Third-Year Mathematics). Pp. 118 + xvii. Price 75 cents + postage.

The first- and second-year books have been reviewed in previous issues. The third volume carries on the methods of the earlier books through the completion of elementary algebra, trigonometry and solid geometry.

It is possible now to obtain a comprehensive view of the entire series, and it seems that the author has produced a consistent scheme for the secondary-school mathematics. If completed in three years it saves a half year over the usual course, and it brings about the correlation between subjects which is the author's object. The solid geometry, alone, seems to stand out as almost a separate subject.

The book of tables which is designed for use with the third volume is a convenient and well-arranged set of logarithmic and trigonometric

tables, with the addition of powers and roots, and the formulas of the elementary subjects. It is open to criticism, however, in that the type is not as large as might be wished.

The set, taken as a whole, seems the best expression of the correlation idea yet written. It should bring excellent results in the hands of teachers in sympathy with the method.

Industrial Arithmetic for Girls. By NELSON L. RORAY. Philadelphia: P. Blakiston's Sons and Company. Pp. 196 + viii. Price 75 cents.

This is described as an "Elementary Text in Home Economics." It presupposes only a knowledge of arithmetic through the seventh grade, but is evidently planned for high school classes. Its object is not only to give a knowledge of the arithmetic most used by girls, but to help form habits of economy in both the individual and the family, and to introduce the pupil to the algebraic method in very simple form, and to geometry, especially the mensuration of plane figures and solids.

The book is quite comprehensive, and includes many practical and useful applications.

Junior High School Mathematics, First Course. By WILLIAM L. VOSBURGH and FREDERICK W. GENTLEMAN. New York: The Macmillan Company. Pp. 146 + vii. Price 75 cents.

This little book is a very interesting addition to texts for the seventh year. Its main divisions are Review of Arithmetic; Equations and Ratios; Measurement; Percentage, Discount and Interest; Mensuration; Summary and Miscellaneous Exercises.

The treatment is simple and concrete enough to stimulate interest. The methods are, on the whole, efficient and carefully worked out. The general impression is that the authors have chosen their material so well that useless drudgery has been eliminated without losing the real content of the course.

Infinitesimal Calculus. By F. S. CAREY. London and New York: Longmans, Green and Co. Section I. Pp. 149. $1.80.

This book is written "for those who wish to use the infinitesimal calculus as an instrument in the attainment of further knowledge." There are some things which the American student will find in this elementary text which may strike him as quite different from corresponding American texts. Besides a few modifications of notations he will find an early introduction of the ideas of *range* and *sequence* and the late introduction of the usual symbol for an indefinite integral. Besides elementary integrations it takes up areas, volumes and moments.

Differential and Integral Calculus. By H. B. PHILLIPS. New York: John Wiley & Sons. $2.00.

This is the author's "Differential Calculus" and "Integral Calculus"

bound in one volume. In treats of the usual topics found in a calculus and has many good features in the way of treatment and order of topics. It should prove very teachable.

College Algebra. By E. B. SKINNER. New York: The Macmillan Co. Pp. 263. $1.50.

The objects of the author of this book are, first, to meet the needs of the growing numbers who are coming to college with but one year of algebra by introducing more of the elementary work, and, second, to introduce more practical applications to the affairs of everyday life, so as to make the subject more vital and interesting.

Under the Witches' Moon. By NATHAN GALLIZIER. Boston: The Page Co. Pp. 455. $1.50 net.

This romantic tale of tenth-century Rome concerns itself with the fortunes and adventures of Tristan of Avalon while in the Eternal City on a pilgrimage to do penance for his love of Hellayne, the wife of his liege lord, Count Roger de Laval. The author is a very versatile and interesting writer and this historical novel will add to his fame.

What Allah Wills. By IRWIN L. GORDON. Boston: The Page Co. Pp. 395. $1.35 net.

This is the story of a young American girl who, in spite of her love for a medical student who has given his life to help the lepers in Morocco, is induced to take up the Mohammedan faith. It is well written.

Famous Discoverers and Explorers of America. By CHARLES H. L. JOHNSTON. Boston: The Page Co. Pp. 426. $1.50.

This volume of the Famous Leaders Series gives a very interesting account of some sixteen of America's explorers and discoverers.

The Sandman: His Kittycat Stories. By HARRY W. FREES. Boston: The Page Co. Pp. 277. $1.50.

An entertaining story of kittens and how they played and got into mischief.

NOTES AND NEWS.

Examinations for positions in the Washington High Schools will be held on December 19 and 20 at the Franklin School Building, 13th and K Sts., Washington, D. C. For further information apply to Harry English, Secretary of the Board of Examiners.

The National Educational Association has joined its efforts to that of the Bureau of Education in the attempt to have the schools coöperate with the Department of Food Administration. The pamphlets being published for use in the schools are very timely and easily used in class. Any teacher who has not seen them should write the Bureau of Education, asking for samples of the "Community Leaflets."

THE twenty-ninth meeting of the Association was held at Vassar College, Saturday, December 1, 1917. The general topic for the morning was "Practical Mathematics and Applied Problems." Interesting papers on this topic were read by Wm. H. Dooley, Brooklyn Navy Yard; Wm. Breckenridge, Teachers College; Geo. Galley Chambers, University of Pennsylvania; Louisa M. Webster, Hunter College; Henry B. Evans, University of Pennsylvania. Dr. Henry S. White, Vassar College, then gave a brief summary of the different papers. Captain Peter Field, U. S. Coast Artillery, followed with an interesting talk on "Mathematics of Warfare." The last paper of the morning was by Elizabeth F. Johnson, The Baldwin School, Bryn Mawr, Pa., on the topic "Is the Present Entrance Requirement in Algebra Excessive in Amount? Does it Expect too Great a Maturity on the Part of the Student?"

The Nominating Committee then gave its report. Upon this recommendation the following officers were elected for the coming year: President, Herbert E. Hawkes, Columbia University, New York City; Vice-President, Alice Deal, Washington, D. C.; Secretary, Ernest H. Koch, Jr., High School of Commerce, New

York City; Treasurer, H. Ross Smith, Southern High School, Philadelphia; Council, Howard F. Hart, Montclair, N. J.

In the afternoon session Mr. Harrison E. Webb, Central High School, Newark, gave a Report of the Committee on Grammar School Mathematics. This was followed by a very interesting illustrated lecture by Clifford B. Upton, Teachers College, on "High School Mathematics as an Aid to the Interpretation of Life About Us."

It seemed to be the opinion of all in attendance that this meeting of the Association was most decidedly interesting and helpful.

New Members.

Mary C. Baxter, 143 West 84th St., New York City.
Kate Garretson, 73 West 124th St., New York City.
Pauline L. Batt, 371 West 116th St., New York City.
Louis A. Chapple, 1630 East 15th St., Brooklyn, N. Y.
Elizabeth W. Whittemore, Hudson Falls, N. Y.
Emily Renshaw, 2321 Wharton St., Philadelphia, Pa.
Isakl Hill, 36 Yard Ave., Trenton, N. J.
W. G. Showman, 5511 Dunkirk St., Pittsburgh, Pa.
Martha Farrell, Whittier Hall, 1230 Amsterdam Ave., New York City.
Julia Robinson, 24 Court St., Auburn, N. Y.
Alice M. Evans, 130 E. Mill St., Ithaca, N. Y.
Ethel M. Gregg, Kane, N. Y.
Helen L. Bancroft, Hiram, Ohio.
Horace M. Roberts, High School, Rome, N. Y.
Mildred I. Jones, 691 State St., Springfield, Mass.
Edith M. Hill, 163 S. Prospect St., Hagerstown, Md.
John W. Shields, 135 Ainslie St., Brooklyn, N. Y.
Irving L. Cohen, 1848 Anthony Ave., Bronx, New York City.
Max Kimmelman, 1451 Prospect Ave., Bronx, New York City.
Jane Spargo, 179 Main St., Flemington, N. J.